STUDY OF THE NEMATODES ASSOCIATED WITH FIBROUS CROPS

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MARCH, 1969

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ALIGARH, U.P.

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By

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This is to certify that the entire work which is being presented in the form of a thesis entitled " Study of the Nematodes associated with Fibrous crops " by Qaiser Husain Baqri was carried out under my supervision during the year 1966-'68. The work is original and has been done by the candidate himself. I have no objection to its being submitted to the Aligarh Muslim University in fulfilment of the requirements for the degree of Doctor of Philosophy in Zoology.

M. Shamim Jairajpuri
Supervisor

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I N T R O D U C T I O N -

Recent research has clearly demonstrated that plant-parasitic nematodes do a considerable damage to our agricultural and horticultural crops. This has led to the emergance of Plant Nematology as an independant discipline of biology. The pathogenic nature of plant nematodes was discovered during the second half of the nineteenth century. The basic work on plant and soil nematodes done by eminent workers like Cobb, de Man, Fusch, Bastian, Schmidt, Bütschli, Steiner, Chitwoods, Thorne, Goodeys was mainly of taxonomic nature. Besides taxonomic work, research on biology, pathogenecity and control measures of plant-parasitic nematodes has also been initiated.

In India, research on plant and soil nematodes began rather late. Only a few forms were known before, 1959. Siddiqi (1959-68), Das (1960), Jairajpuri (1963-68), Seshadri (1962-67), Khan, E. (1963-68), Husain and Khan, A.M. (1965-68), Khera (1966-68) and others have made significant contributions in the field of Plant Nematology. So far, about 400 species of the Orders Tylenchida and Dorylaimida have been described from India. However, the taxonomic work has not been done in a planned way. In other words, no attempt has been made to carry out qualitative and quantitative surveys of nematodes so as to obtain their complete record, relative abundance and

degree of dominance in relation to a particular crop or a group of crops. Beside taxonomic value such work provide inevitable base for carrying out research on biology, ecology and control of nematodes.

The present work was started in January, 1966. It deals with the taxonomic studies of nematodes associated with some economically important fibrous crops of India and also gives their geographical distribution and quantitative estimation in Uttar Pradesh. The crops selected include 3 species of cotton, viz., Gossypium hirsutum L., G. herbaceum L., and G. arboreum L.; the sun hemp, Crotalaria juncea L., and the patson, Hibiscus cannabinus L. Among these crops, cotton is one of the most important commercial and industrial crop because of its use in the textile, paper and tyre industries. The sun hemp and patson are used for making cordage, sacks, nets and coarse canvas etc.

In the present work a thorough check-up of stable and non-stable taxonomic characters has been done resulting in considerable re-evaluation of these characters. This could only be done by introducing an elaborate and broad-based description of the taxa concerned, using a large number of specimens representing several populations obtained from different localities and hosts. Consequently, detailed descriptions are provided for all the new species supported by adequate number of illustrations. Some known species

were also recorded, and where necessary, these are redescribed in greater details. Such a revision has obviously led to a better understanding of the species and in some cases synonyms have been declared. This is evident from the fact that while working on the genus Tylenchorhynchus Cobb, 1913 the following five species were considered synonyms of T. mashhoodi Siddiqi and Basir, 1959: Tylenchorhynchus dactylurus Das, 1960; T. digitatus Das, 1960; T. crassicaudatus Williams, 1960; T. elegans Siddiqi, 1961 and T. zeae Sethi and Swarup, 1968. Similarly four species of Thornenema Andrassy, 1959 were considered synonyms of Thornenema mauritiana (Williams, 1959) n. comb.: Thornenema viriosum Williams, 1964; T. filiforme Siddiqi, 1965; T. delhiensis Prasad and Chawla, 1965 and T. africanum Andrassy, 1965. For a few species, specimens collected before 1966 and from hosts other than the fibrous crops have also been included in the present study in order to make the descriptions as elaborate as possible.

The present work deals with the taxonomic studies on the Orders Tylenchida and Dorylaimida from India, it gives the geographical distribution of these nematodes in Uttar Pradesh and contains an account on the quantitative estimation of nematodes associated with cotton in major cotton growing districts of Uttar Pradesh. In all, 100 species of nematodes have been reported under 24 families. They represent 2 new genera, 24 new species and 76 known species of which 11 have been recorded for the first time from India. Two new

combinations under Dorylaimidae de Man, 1876, and one under Leptonchidae Thorne, 1935 are also proposed. The 24 new species are assigned to the following families: Five Tylenchidae Örley, 1880; six Dorylaimidae; five Aporcelaimidae; five Leptonchidae; two Dorylaimellidae (Jairajpuri, 1964) Thorne, 1964 and one Alaimidae Micoletzky, 1922. The males of some known species have also been recorded for the first time. Whereever necessary, identification keys to the species of genera have been provided.

MATERIAL AND METHODS

Soil Sampling:

Soil samples from around roots of fibrous crops were collected from a depth of 4-10 inches. Twenty five sub-samples per acre were taken to form one bulk sample. These samples were stored in polythene bags and kept in the refrigerator maintained at 5-7°C until processing for isolation of the nematodes.

Processing of Samples:

Approximately 500 ml. of soil was placed in a bucket, filled to 1/3rd of its volume with water. The soil and water were thoroughly mixed to get an uniform suspension. This was left undisturbed for about 10 seconds so as to allow the heavy particles to settle down at the bottom of the bucket, while the nematodes and fine soil particles remained suspended. This suspension was then filtered through a coarse sieve to get rid of debris and was collected in another bucket. The entire process was repeated twice. The suspension finally obtained was quite free from stones, leaves and other undesirable organic matter. It was passed through a set of two sieves of 300 mesh number (pore size 53 u). Most of the fine soil particles escaped through the sieves, while the nematodes and larger soil particles were

retained. The entire 'catch' from both the sieves was collected in a beaker.

Isolation of Nematodes:

The aliquot collected in this manner was poured on a nylon filter paper placed on a coarse sieve. The latter was then placed for 24 hours in a petri-dish filled with small quantity of water which barely touched the bottom of the filter paper. Majority of the active nematodes passed through the filter paper into the clean water of the petri-dish. The final suspension was normally clear enough to facilitate microscopic observation. The residue on the filter paper was examined thoroughly under a stereoscopic binocular microscope for sluggish nematodes, e.g., members of the Criconematoidea.

Killing and Fixing:

The suspension containing the nematodes was placed in a large test tube for 2-3 hours so that they could settle down at the bottom and most of the supernatant could be discarded. The nematodes were killed by using hot (Approx. 50-60^{o}C) 8% formalin (double strength) and were left in the fixative for at least 24 hours. The fixative was taken approximately twice the volume of supernatant containing the nematodes. Hot formalin proved to be a good fixative, since it kills and fixes the worms immediately in their characteristic postures. The nematodes can also be stored

safely in this solution for long periods and can also be mounted temporarily in this medium for microscopic examination.

Mounting and Sealing:

Temporary mounts were prepared either in water or in 4% formalin. While water mounts last only a few days, formalin mounts remained useful for several weeks. For permanent mounts the material was transferred to a mixture of 5 parts glycerine and 95 parts 30% alcohol in a glass cavity block. While in this mixture, they were kept in a desiccator and were allowed to dehydrate at room temperature for 2-3 weeks. They were then finally mounted in pure dehydrated glycerine between two coverslips on metallic slides. Glass-wool of suitable thickness was placed in between the coverslips to prevent pressure on the specimens. Temporary water or formalin mounts were sealed with a mixture of 50% wax and 50% vaseline and permanent glycerine mounts with Glyceel prepared by G.T. Gurr Ltd., London.

Measurements and Drawings:

de Man's (1884) formula for denoting the dimensions of the nematodes have been used. All measurements and observations were made on specimens mounted in dehydrated glycerine. An ocular micrometer was always used for taking measurements. All illustrations were made with the help of a camera lucida.

Type Material:

The type material has been labelled and deposited with the Zoology Museum of Aligarh Muslim University, Aligarh.

For the sake of priority descriptions of some of the new species have already been published with the permission of the Head, Department of Zoology, Aligarh Muslim University, Aligarh. However, for the sake of uniformity, they have been presented here as new species.

ORDER TYLENCHIDA THORNE, 1949

SUPERFAMILY TYLENCHOIDEA (Örley, 1880) Chitwood and Chitwood, 1937

FAMILY TYLENCHIDAE Örley, 1880

The survey of plant and soil nematodes associated with fibrous crops yielded a large number of nematodes of the family Tylenchidae. These represent 24 species of the following 8 genera: 4 Tylenchus Bastian, 1865; 3 Ditylenchus Filipjev, 1936; one Pseudhalenchus Tarjan, 1958; 2 Psilenchus de Man, 1921; one Basiria Siddiqi, 1959; 2 Clavilenchus (Jairajpuri, 1966) Thorne and Malek, 1968; 9 Tylenchorhynchus Cobb, 1913 and 2 Telotylenchus Siddiqi, 1960. Five of these species, one Clavilenchus, 2 Tylenchorhynchus and 2 Telotylenchus are new to science and described below in detail. Clavilenchus tumidus, Tylenchorhynchus goffarti and Ditylenchus microdens are new records for India.

SUBFAMILY TYLENCHINAE (Örley, 1880) Marcinowski, 1909

GENUS TYLENCHUS Bastian, 1865

Nearly 60% of the soil samples examined were found to contain species of this genus. Although abundant in their distribution, the number of specimens obtained for each of the species was always low. The specimens are classified into 4 species.

Tylenchus striatus Das, 1960

Habitats: i) Four females from Gossypium herbaceum from district Banaras, U.P.

ii) Three females from Crotalaria juncea from district Jhansi, U.P.

Tylenchus leptus Siddiqi, 1963

Habitats: i) Fifteen females from Gossypium hirsutum from district Aligarh, U.P.

ii) Several females from Gossypium herbaceum from district Mainpuri, U.P.

iii) Twenty females from Crotalaria juncea from Banaras and Jhansi districts of U.P.

Tylenchus ritai Siddiqi, 1963

Habitats: i) Several females from Gossypium herbaceum from Badaun, Bijnor, Bulandshahr, Etah, Meerut, Moradabad, Muzaffarnagar and Saharanpur districts of U.P.

ii) Ten females from Crotalaria juncea from district Jhansi, U.P.

iii) Sixteen females from Hibiscus cannabinus from district Mirzapur, U.P.

Tylenchus arcuatus Siddiqi, 1963

Habitats: i) Nine females from Gossypium hirsutum from district Mathura, U.P.

ii) Several females and males from Gossypium herbaceum from Moradabad, Muzaffarnagar and Rampur districts of U.P.

iii) Seven females and 2 males from Crotalaria juncea from district Jhansi, U.P.

GENUS DITYLENCHUS Filipjev, 1936

Ditylenchus nanus Siddiqi, 1963

Habitats: i) Several females and males collected from Gossypium hirsutum from Aligarh, Badaun, Etah, Mathura, Meerut and Moradabad districts of U.P.

ii) Several females and males from Gossypium herbaceum from Bijnor, Bulandshahr, Mainpuri, Meerut, Muzaffarnagar and Rampur districts of U.P.

iii) Twenty females and males from Crotalaria juncea from district Banaras, U.P.

Ditylenchus mirus Siddiqi, 1963

Habitats: i) Forty females and males from Gossypium hirsutum from district Aligarh, U.P.

ii) Several females and males from Gossypium herbaceum from Etawah, Meerut and Saharanpur districts of U.P.

iii) Several females and males from Hibiscus cannabinus from Jalaun, Jhansi and Mirzapur districts of U.P.

Ditylenchus microdens Thorne and Malek, 1968

This species has recently been described from soils of cultivated fields of Northern Great plains of North America. It is here recorded for the first time from India.

Habitat: Three females collected from Crotalaria juncea from Tangra, district Banaras, U.P.

GENUS PSEUDHALENCHUS Tarjan, 1958

Pseudhalenchus anchilisposomus Tarjan, 1958

Habitat: Four females from Crotalaria juncea from district Jhansi, U.P.

SUBFAMILY PSILENCHINAE Paramonov, 1967

GENUS PSILENCHUS de Man, 1921

Psilenchus minor Siddiqi, 1963

Habitat: Ten females from Crotalaria juncea from district Jhansi, U.P.

Psilenchus neoformis Jairajpuri, 1963

Syn. Psilenchus hilarus Siddiqi, 1963

Examination of the present material as well as the type specimens of P. neoformis reveals that P. hilarus falls well within the range of this species and therefore is its synonym.

Habitat: Fifteen females from Gossypium herbaceum from district Muzaffarnagar, U.P.

GENUS BASIRIA Siddiqi, 1959

Basiria graminophila Siddiqi, 1963

Habitat: Eight specimens from Gossypium herbaceum from district Rampur, U.P.

GENUS CLAVILENCHUS (Jairajpuri, 1966) Thorne and Malek, 1968

Jairajpuri (1966) proposed the subgenus Clavilenchus under the genus Tylenchus Bastian, 1865 to accommodate the species Psilenchus tumidus Colbran, 1960 which has slit-like, post-labial amphidial apertures; spear with distinct basal knobs; median esophageal bulb anterior to middle of esophagus; single ovary and long filiform tail with a clavate terminus. Recently, Thorne and Malek (1968) gave a full generic rank to Clavilenchus under the subfamily Psilenchinae because of the characters of amphids and the shape of tail.

Clavilenchus tumidus (Colbran, 1960) Thorne and Malek, 1968

Habitat: Six females and 6 males from Gossypium herbaceum from Mukhtarpur, district Bijnor, U.P.

*Clavilenchus ritteri** n. sp.

(Plate: I)

Dimensions:

i) Deoband population (Type population): Females (4): L= 0.48-0.59 mm.; a= 29-37; b= 4.5-5.3; c= 9-13; V= 72-77.

Female (holotype): L= 0.61 mm.; a= 38; b= 5.1; c= 9; V= 75.

Male (1): L= 0.59 mm.; a= 34; b= 5.1; c= 9; T= 30.

ii) Malpura population: Females (3): L= 0.57-0.68 mm.; a= 34-38; b= 5.3-6.5; c= 9-11; V= 71-75.

Males (2): L= 0.47-0.61 mm.; a= 36-44; b= 5.9-61; c= 9; T= 29-42.

Description:

Female: Body slightly ventrally arcuate upon fixation. Cuticle with distinct transverse striations, each about 1 μ apart. Lateral fields about a quarter of body-width, marked with four incisures. Amphidial apertures 3 μ wide, slit-like, situated posterior to base of lateral lips. Deirids not seen. Hemizonid prominent, 2-4 annules above the excretory pore.

Head slightly set off by a depression from body, smoothly rounded. Spear slender, 9-10 μ, knobbed at base, the anterior tapering tip 3-4 μ. Orifice of the dorsal

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*Named after Mr. M. Ritter, Institut National de la Recherche Agronomique, Antibes, France.

esophageal gland situated 3 μ behind base of spear. Distance from anterior end of body to the centre of the median bulb about half the distance from the latter to the base of esophagus. Median esophageal bulb ovate with distinct valvular apparatus. Isthmus narrower than procorpus in Deoband population but nearly of the same thickness in Malpura population. Nerve ring 57-67 μ from anterior end. Basal esophageal bulb pyriform. Cardia rounded.

Vulva a transverse slit. Vagina about half the corresponding body-width. Ovary single, prodelphic, outstreched; oocytes arranged in a single row except at tip. Posterior uterine sac more than half the corresponding body-width. Rectum 9-11 μ, about one anal body-width. Tail elongate, filiform, 5-8 times the anal body-width, with a swollen but irregularly notched tip.

Male: Similar to female in general morphology. Testis single outstretched. Spicules 16-17 μ, arcuate. Gubernaculum 4-5 μ, slightly arcuate. Bursa with crenate margins. Tail as in female.

Habitat: Deoband population (Type): Soil around roots of Gossypium herbaceum from Deoband, district Saharanpur, U.P.

Malpura population: Soil around roots of Crotalaria juncea from Malpura, district Agra, U.P.

Type specimens: Collected in October, 1966; holotype mounted on slide MSJ/Clavilenchus ritteri/1; paratypes on slide MSJ/Clavilenchus ritteri/2; specimens from Malpura, district Agra on slide MSJ/Clavilenchus ritteri/3.

Differential diagnosis: Clavilenchus ritteri n. sp., comes close to Clavilenchus tumidus (Colbran, 1960) Thorne and Malek, 1968, but differs in having a smaller spear, in the position of excretory pore, the entire tail annulated and the tail tip swollen but irregularly notched.

SUBFAMILY TYLENCHORHYNCHINAE Eliava, 1964

Eliava (1964) proposed Tylenchorhynchinae under Hoplolaimidae (Filipjev, 1934) Wieser, 1953 for the genus Tylenchorhynchus Cobb, 1913 because of its having moderately developed head sclerotization, spear with parallel protractor muscles, ray-like phasmids and large enveloping bursa. Paramonov (1967) agrees with Eliava (l.c.) and regards Tylenchorhynchinae under Hoplolaimidae. However, Husain and Khan (1967), Allen and Sher (1967) and Thorne and Malek (1968) placed Tylenchorhynchinae under Tylenchidae. This subfamily contains species which possess characters of both the families Tylenchidae and Hoplolaimidae. In the present work, Tylenchorhynchinae has been retained under Tylenchidae.

GENUS TYLENCHORHYNCHUS Cobb, 1913

The survey of plant and soil nematodes associated with fibrous crops in India (specially Uttar Pradesh) revealed that the species of this genus are widely distributed. The following 22 species of the genus Tylenchorhynchus have so far been reported from India:

1. Tylenchorhynchus capitatus Allen, 1955
2. T. brevidens Allen, 1955
3. T. acutus Allen, 1955
4. T. nudus Allen, 1955
5. T. martini Fielding, 1956
6. T. ewingi Hopper, 1959
7. T. coffeae Siddiqi, 1959
8. T. mashhoodi Siddiqi and Basir, 1959
9. T. dactylurus Das, 1960
10. T. digitatus Das, 1960
11. T. indicus Siddiqi, 1961
12. T. brassicae Siddiqi, 1961
13. T. elegans Siddiqi, 1961
14. T. divittatus Siddiqi, 1961
15. T. rugosus Siddiqi, 1963
16. T. nilgriensis Seshadri et al., 1967
17. T. chonai Sethi and Swarup, 1968
18. T. zeae Sethi and Swarup, 1968
19. T. phaseoli Sethi and Swarup, 1968

20. Tylenchorhynchus berberidis Sethi and Swarup, 1968
21. T. delhiensis Chawla et al., 1968
22. T. acti Chawla et al., 1968

Of these species, Tylenchorhynchus indicus is a synonym of T. brevilineatus Williams, 1960 (vide Siddiqi, 1963) and T. rugosus of T. quadrifer Andrássy, 1954 (vide Tarjan, 1964).

In the present work, two new species of Tylenchorhynchus are described and a detailed study of Tylenchorhynchus mashhoodi based on a large number of specimens from different localities of Uttar Pradesh has been done. Tylenchorhynchus dactylurus, T. digitatus, T. crassicaudatus Williams, 1960, T. elegans and T. zeae are considered synonyms of T. mashhoodi. Redescription of T. martini based on an Indian population as well on specimens from the type locality has been given. A brief description of T. goffarti, recorded for the first time from India, is provided. Tylenchorhynchus divittatus and T. brassicae are reported from various localities. Tylenchorhynchus capitatus and T. brevidens were also found.

Tylenchorhynchus mashhoodi Siddiqi and Basir, 1959

(Plates: II & III)

Synonyms: Tylenchorhynchus dactylurus Das, 1960

T. digitatus Das, 1960

T. crassicaudatus Williams, 1960

T. elegans Siddiqi, 1961

T. zeae Sethi and Swarup, 1968

Dimensions: Table I.

Description:

Female: Body curved in posterior half of its length upon fixation and tapering slightly towards extremities. Cuticle marked with distinct transverse striae, 1-2 μ apart. Longitudinal striations absent. Lateral fields originate with two incisures near middle of spear, become three near middle of procorpus and four at the level of nerve ring; the outer ones are crenate. The four incisures extend up to the tail terminus. There is no indication of aerolations. Width of lateral fields 1/4th-1/3rd the body-width near middle.

Lip region continuous with body contour, flat at apex, bearing 3-4 annules, 6-7 μ wide and 3-4 μ high. Head framework slightly sclerotized. Spear 16-19 μ long, delicate, anterior part (metenchium) 8-10 μ long or 50-55% of spear length. Base of spear with 3 large, rounded or slightly pointed knobs, 3-4 μ wide. Esophagus typical. Median esophageal bulb ovate; at 44-50% of the esophageal length from

anterior end; 11-15 μ long and 6-10 μ wide. Orifice of dorsal esophageal gland 1-3 μ from spear base. Nerve ring 75-104 μ from anterior end, along middle of isthmus. Excretory pore 85-122 μ from anterior end, its position varies between anterior end to slightly below the middle of terminal bulb. Hemizonid prominent, 1-2 annules long, situated 1-3 annules above the excretory pore. Deirids near the middle of the terminal bulb, usually in level with the excretory pore.

Vulva a transverse slit. Vagina extending 7-11 μ across the body, 1/3rd-1/2 the corresponding body-width. Gonads amphidelphic, outstretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca ovate or spherical and filled with sperms. Oocytes arranged in a single row, double row at the tip. Tail narrowing behind anus, cylindrical or subcylindrical in shape; ending in flat, rounded, broadly rounded, bluntly conoid or notched (in one specimen) terminus; marked with 14-29 striae ventrally and 2.5-4.0 anal body-widths long. Phasmids in the anterior half (28-37%) of the tail.

Male: The four incisures of the lateral fields gradually expand on tail. The outer incisure of dorsal side reaches beyond phasmids and faints away; while that of ventral side reaches near the proximal end of spicules. The inner two reach up to the latitude of anus. Spicules 18-22 μ long medially. Gubernaculum stout, 10-15 μ long, proximal half slightly or distinctly curved upwards and often with a minute

knob. Tail elongate-conoid with acute or subacute terminus; 2.3-3.0 anal body-widths long. Phasmids in the anterior half to half way (31-50%) of the tail.

Discussion: Das (1960) described Tylenchorhynchus dactylurus and T. digitatus which are quite similar to each other in many respects. He separated them on the basis that the male tail of T. digitatus is shorter and conoid and the female tail straight, while in T. dactylurus the female tail is marked by slight constriction posterior to anus. All the other characters including the body dimensions are almost identical. Williams (1960) reported Tylenchorhynchus crassicaudatus from Mauritius and separated it from T. martini by its more anteriorly situated phasmids and by the presence of a spermatheca. Siddiqi (1961) described Tylenchorhynchus elegans from India and differentiated it from T. mashhoodi and T. digitatus. As pointed out by Siddiqi (l.c.) T. elegans differs from T. mashhoodi in having less coarsely striated cuticle, a weak buccal spear and a longer tail bearing 23 annules and from T. digitatus by a coarsely striated body cuticle, a smaller buccal spear and spicules. A recently described species, Tylenchorhynchus zeae Sethi and Swarup, 1968 differs from T. mashhoodi by its longer and differently shaped tail.

The above mentioned species were mostly described on small number of specimens and variations were not studied. The present study on Tylenchorhynchus mashhoodi is based on

large number of specimens from different localities which show great variations in the length and shape of tails, number of tail annules (14-29), length of spear (16-19 μ), length and shape of spicules and gubernaculum. It is quite evident from the present study as well as examination of the type specimens of Tylenchorhynchus mashhoodi, T. crassicaudatus, T. elegans and T. zeae that they fall well within the variations of T. mashhoodi. Unfortunately, the type specimens of Tylenchorhynchus dactylurus and T. digitatus were not available for study, but the descriptions as provided by Das (1960) falls well within the variations given above for T. mashhoodi and therefore T. dactylurus and T. digitatus are also its synonyms.

Differential diagnosis: Tylenchorhynchus mashhoodi Siddiqi and Basir, 1959 comes very close to Tylenchorhynchus martini Fielding, 1956, but differs in having a spermatheca and by the presence of males.

Habitats: i) Soil around roots of Gossypium herbaceum from Deoband, district Saharanpur; Shamli, district Muzaffarnagar; Mehalwala and Dabathwa, district Meerut and Kaishupur, district Etawah, U.P.

ii) Soil around roots of Crotalaria juncea from Sanda Brona, district Allahabad; Banatwa, district Banaras, U.P.

iii) Soil around roots of Hibiscus cannabinus from Personpur, district Mirzapur, U.P.

T A B L E I

Tylenchorhynchus mashhoodi

Population	No. of specimens	Length in mm.	a	b	c	V	T
DEOBAND	40 (♀♀)	0.63 (0.54-0.72)	32 (28-37)	5.1 (4.4-5.8)	16 (13-18)	56 (52-58)	
	15 (♂♂)	0.62 (0.57-0.66)	30 (27-35)	5.2 (4.5-5.6)	16 (14-17)		46 (36-50)
SHAMLI	6 (♀♀)	0.49-0.62	29-38	4.7-6.5	16-22	50-59	
	2 (♂♂)	0.47-0.62	28-34	4.6-5.2	15-17		44-46
MEHALWALA	3 (♀♀)	0.56-0.60	30-33	4.7-5.1	15-17	55-56	
DABATHWA	3 (♀♀)	0.56-0.60	29-31	5.0-5.2	15-17	56-58	
	2 (♂♂)	0.51-0.61	28-30	4.8-5.1	15-16		38-40
SANDA BRONA	10 (♀♀)	0.58-0.65	29-37	5.3-5.4	13-19	55-58	
	3 (♂♂)	0.58-0.69	33-34	5.3-5.8	14-16		45-50
BANTWA	6 (♀♀)	0.59-0.68	28-33	4.6-5.5	15-17	53-57	
KAISHUPUR	5 (♀♀)	0.51-0.61	29-33	4.8-5.4	14-17	54-56	

TABLE I (Contd.)

Population	No. of specimens	Length in mm.	a	b	c	V	T
PERSONPUR	8 (♀♀)	0.58-0.69	31-36	5.0-5.5	15-18	53-57	
	2 (♂♂)	0.50-0.56	30-33	4.7-5.4	15-17		47-51

Additional localities: Several females and males of this species were also collected from various localities of the following districts of Uttar Pradesh: Agra, Aligarh, Banaras, Bijnor, Bulandshahr, Etah, Ghazipur, Kanpur, Meerut, Muzaffarnagar, Rampur, Saharanpur and Shahjahanpur.

Tylenchorhynchus martini Fielding, 1956

(Plate: IV)

Dimensions:

i) Louisiana population (Topotypes): Females (11): L= 0.68 mm. (0.63-0.73 mm.); a= 34 (30-38); b= 4.8 (4.3-5.3); c= 14 (13-15); V= 56 (53-58).

ii) Banbasa population: Females (12): L= 0.72 mm. (0.61-0.85 mm.); a= 35 (31-37); b= 5.1 (4.6-5.7); c= 14 (12-16); V= 55 (52-57).

Description:

Female: Body curved in posterior half of its length or 'C' shaped upon fixation and tapering slightly towards both extremities. Cuticle marked with distinct transverse striae, 1-2 μ apart, farther apart on tail. Longitudinal striations absent. Lateral fields 1/4th-1/3rd the body-width near middle. Aerolations in the lateral fields not seen.

Lip region continuous with body contour, set off by a slight depression in topotypes; flat or rounded at apex; bearing three annules, 3 μ high and 7 μ wide. Spear 17-19 μ long, anterior part (metenchium) 9-10 μ or 50-55% of spear

length. Base of spear with three large, slightly pointed knobs, 3-4 μ wide. Esophagus typical. Median esophageal bulb ovate; 40-46% of esophageal length from anterior end; 14-16 μ long and 9-10 μ wide. Orifice of dorsal esophageal gland 1-2 μ from spear base. Excretory pore 97-112 μ from anterior end. Hemizonid 1-2 striae long, situated 1-4 striae above the excretory pore.

Vagina 1/3rd-1/2 the corresponding body-width. Spermatheca absent. Tail cylindrical or subcylindrical; ending in a smooth, broadly rounded, narrowly rounded or flat terminus; marked with 21-36 striae ventrally and about 3.0-4.8 anal body-widths long. Phasmids at 34-37% of the tail.

Habitats: i) Louisiana population (Topotypes): Collected from soil around roots of sugarcane hybrid, Saccharum officinarum from Laplace, Louisiana.

ii) Banbasa population: From soil around roots of Hibiscus cannabinus from Banbasa, district Nainital, U.P.

Tylenchorhynchus goffarti Sturhan, 1966

(Plate: V, Figs. A-D)

Dimensions:

Females (7): L= 0.60-0.69 mm.; a= 34-40; b= 5.1-5.9; c= 12-14; V= 53-57.

Males (5): L= 0.52-0.67 mm.; a= 35-43; b= 5.0-5.8; c= 12-15; T= 41-51.

Description:

Female: Cuticle marked with distinct transverse striae, 1 μ apart. Longitudinal striations absent. Lateral fields averaging about 1/3rd the corresponding body-width near middle. Head set off, bearing 6-7 annules. Spear 13-15 μ long, anterior part (metenchium) 7-8 μ or about 55% of spear length. Base of spear with three rounded knobs. Esophagus typical. Orifice of dorsal esophageal gland 1-2 μ from spear base. Excretory pore near middle of basal esophageal bulb. Hemizonid 5-7 striae above the excretory pore. Post-anal intestinal sac present. Tail marked with 35-48 striae and 3.5-4.2 anal body-widths long. Phasmids in anterior third of tail.

Male: Spicules slightly arcuate, 18-19 μ long medially. Gubernaculum 9-10 μ long. The four incisures of the lateral fields gradually expand on tail. Only the outer incisure of the dorsal side reaches beyond phasmids. Tail 3.2-3.8 anal body-widths long.

Habitat: Soil around roots of Hibiscus cannabinus from Gyanpur, district Banaras, U.P.

Tylenchorhynchus divittatus Siddiqi, 1961

(Plate: V, Figs. E-I)

Dimensions:

Females (50): L= 0.58 mm. (0.47-0.67 mm.); a= 35 (25-43); b= 5.6 (4.8-6.7); c= 20 (17-23); V= 55 (53-59).

Males (30): L= 0.58 mm. (0.50-0.65 mm.); a= 36 (30-42); b= 5.5 (5.1-6.3); c= 18 (16-20); T= 50 (47-55).

The tail shape and the manner of termination of lateral lines in female are variable from that shown by Siddiqi (1961).

Habitats: i) Several hundred females and males were collected from soil around roots of Gossypium herbaceum from Allahabad, Etawah and Kanpur districts of Uttar Pradesh.

ii) Several hundred females and males from soil around roots of Crotalaria juncea from Banaras, Jalaun, Jhansi and Mirzapur districts of Uttar Pradesh.

Tylenchorhynchus brassicae Siddiqi, 1961

Dimensions:

Females (50): L= 0.63 mm. (0.55-0.74 mm.); a= 33 (28-39); b= 5.6 (5.1-6.6); c= 15 (13-17); V= 54 (50-59).

Males (25): L= 0.62 mm. (0.56-0.72 mm.); a= 35 (31-42); b= 5.4 (5.0-6.4); c= 14 (12-17); T= 54 (49-62).

Habitats: i) Several females and males from soil around roots of Gossypium herbaceum from Badaun, Bulandshahr, Etawah, Mainpuri, Mathura, Meerut, Muzaffarnagar and Saharanpur districts of Uttar Pradesh.

ii) Few females and males from soil around roots of Gossypium arboreum from Aligarh and Badaun districts of Uttar Pradesh.

iii) Several females and males from soil around roots of Crotalaria juncea from Allahabad, Jhansi and Mainpuri districts of Uttar Pradesh.

Tylenchorhynchus capitatus Allen, 1955

Dimensions:

Females (22): L= 0.70 mm. (0.63-0.76 mm.); a= 34 (30-37); b= 5.2 (4.9-5.6); V= 55 (54-57).

Habitat: Soil around roots of Crotalaria juncea from Nainital, U.P.

Tylenchorhynchus brevidens Allen, 1955

Dimensions:

Females (6): L= 0.51-0.64 mm.; a= 29-32; b= 4.1-4.6; c= 12-14; V= 57-60.

Habitat: Soil around roots of Gossypium herbaceum from Mehalwala, district Meerut, U.P.

Tylenchorhynchus hexincisus n. sp.

(Plate: VI)

Dimensions:

i) Citrus population (Type population): Females (4): L= 0.85-1.08 mm.; a= 32-39; b= 6.0-8.2; c= 18-23; V= 52-55.

Female (holotype): L= 1.01 mm.; a= 31; b= 7.5; c= 13; V= 53.

Males (6): L= 0.80-1.08 mm.; a= 32-43; b= 6.0-7.4; c= 13-20; T= 37-46.

ii) Sun hemp population: Female (1): L= 0.99 mm.; a= 37; b= 7.7; c= 23; V= 52.

Male (1): L= 0.89 mm.; a= 43; b= 7.0; c= 17; T= ?.

Description:

Female: Body ventrally arcuate when relaxed and tapering gradually towards extremities. Cuticle marked with transverse as well as longitudinal striations. Transverse striae about 1 μ apart near middle of body, wider near head end and less wide on tail. Longitudinal striae 3 μ apart, numbering 16 near middle of body, 10-12 in esophageal and tail regions. Lateral fields arise as 2 incisures at level of middle of spear, become 3 near median esophageal bulb, 4 near nerve ring and 6 slightly behind the base of esophagus. They continue with 6 incisures until slightly behind the phasmids where they become 5, then 4 immediately afterwards and finally terminate with 3 incisures. Width of lateral fields averaging 1/5th the corresponding body-width.

Head definitely set off, flat at apex and marked with 6 minute but distinct striae. Head framework present, but not obviously sclerotized. Spear 17-19 μ, delicate, anterior part (metechium) 10-12 μ or 60-62% of spear length. Base of spear with 3 distinct, posteriorly sloping knobs, 3-4 μ wide. Esophagus typical. Orifice of dorsal esophageal gland 3-4 μ from the base of spear. Nerve ring along middle or slightly behind middle of isthmus. Excretory pore near middle or posterior to middle of basal esophageal bulb. Hemizonid 3-4 striae long, situated 3-8 striae above the excretory pore. Deirids not seen. Cardia rounded.

Vulva a transverse slit. Gonads amphidelphic, outstretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca small, spherical, without sperms. Tail subcylindrical, 3-4 anal body-widths long, tapering towards tip which is distinctly annulated. Phasmids near middle of tail.

Male: Male reproductive organs typical. Spicules slightly arcuate, 28-31 μ medially. Gubernaculum 8-9 μ, trough-shaped laterally. Bursa moderately developed, with crenate margins. Cloacal opening with protruding lips. Phasmids near middle of tail.

Habitat: Citrus population (Type): Soil around roots of Citrus plants (unidentified) from Veraval, Gujrat.

Sun hemp population: Soil around roots of Crotalaria juncea from Veraval, Gujrat.

Type specimens: Collected in November, 1964; holotype female and one paratype male on slide MSJ/Tylenchorhynchus hexincisus/1; other paratypes on slide MSJ/Tylenchorhynchus hexincisus/2. The specimens of sun hemp population on slide MSJ/Tylenchorhynchus hexincisus/3.

Differential diagnosis: Tylenchorhynchus hexincisus n.sp., in having 6 incisures in lateral fields, cuticle with longitudinal striae and tail terminus annulated comes close to Tylenchorhynchus tessellatus J.B. Goodey, 1952 but differs from it in having the following characters: Lateral fields narrow (1/3rd body-width in T. tessellatus) and their pattern

is different on tail; only 16 longitudinal striae which continue well up to posterior extremity (longitudinal striae 48 near middle of body in T. tessellatus and fade away in the posterior half of body); nerve ring in the middle or posterior to middle of isthmus (close to median esophageal bulb in T. tessellatus); smaller and differently shaped spicules (spicules 34 μ and wider towards proximal end in T. tessellatus) and smaller gubernaculum (11-12 μ in T. tessellatus).

Tylenchorhynchus mujtabai* n. sp.

(Plate: VII)

Dimensions:

i) Kaishupur population (Type population): Females (6): L= 0.51-0.69 mm.; a= 31-38; b= 5.0-5.8; c= 13-15; V= 52-57.

Female (holotype): L= 0.58 mm.; a= 32; b= 5.0; c= 15; V= 55.

Males (5): L= 0.58-0.67 mm.; a= 31-48; b= 5.0-5.4; c= 13-18; T= 45-58.

ii) Kaurpur population: Females (10): L= 0.61 mm. (0.51-0.66 mm.); a= 33 (31-37); b= 5.3 (5.0-5.8); c= 14.5 (14-15); V= 55 (54-56).

Males (8): L= 0.62 mm. (0.57-0.69 mm.); a= 35 (32-38); b= 5.2 (5.0-5.5); c= 15 (14-16); T= 55 (53-61).

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*Named after Syed Hasan Mujtaba Baqri, who collected the soil sample containing these worms.

Description:

Female: Body curved in posterior half of its length upon fixation and tapering slightly towards extremities. Cuticle marked with distinct transverse striae, about 1 μ apart. Longitudinal striations absent. Lateral fields originate with 2 incisures near middle of spear, become 3 in the anterior third of procorpus and 4 below the median bulb. These 4 incisures extend slightly below the anterior half of tail then inner 2 unite and these 3 continue up to tail terminus. The outer incisures are crenate throughout the entire length. Closer examination shows two rows of punctations in the outer bands of lateral fields.

Head set off, marked by 5-6 striae. Head framework slightly sclerotized. Spear 15-17 μ long, delicate; its anterior part (metenchium) 8-9 μ long or 50-56% of spear length. Base of spear with 3 large, rounded, sloping knobs. Esophagus typical. Median esophageal bulb ovate; at 48-52% of the esophageal length from anterior end, 12-15 μ long and 7-9 μ wide. Orifice of dorsal esophageal gland 1-2 μ from spear base. Nerve ring 68-89 μ from anterior end, along middle of isthmus. Excretory pore 89-114 μ from anterior end, its position varies between anterior to middle of terminal bulb. Hemizonid prominent, 2-4 annules long, situated 2-6 annules above the excretory pore. Deirids near middle of terminal bulb, usually in level of the excretory pore.

Vulva a transvers slit. Vagina extending 9-11 μ across the body, about 1/2 the corresponding body-width. Gonads amphidelphic, outstretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca filled with sperms. Oocytes arranged in single or double rows. Tail broader at anus then tapering to posterior extremity, subcylindrical in shape with smooth rounded terminus; marked with 30-48 striae ventrally; 2.5-4 anal body-widths long. Phasmids in the anterior third of tail.

Male: The 4 incisures of the lateral fields gradually expand on tail. The outer incisure of the dorsal side reaches beyond the phasmids and faints away, while that of ventral side reaches near the cloaca, the inner two reach up to the level of phasmids. Spicules 22-25 μ long medially. Gubernaculum stout, 9-11 μ, proximal end distinctly curved upwards. Tail elongate-conoid with subacute terminus, 2.5-3 anal body-widths long. Phasmids in the anterior third of tail.

Habitat: Kaishupur population (Type): Soil around roots of Gossypium herbaceum from Kaishupur, district Etawah, U.P.

Kaurpur population: Soil around roots of Gossypium herbaceum from Kaurpur, district Mainpuri, U.P.

Type specimens: Holotype female along with 2 paratype males mounted on slide MSJ/Tylenchorhynchus mujtabai/1; paratypes mounted on slides MSJ/Tylenchorhynchus mujtabai/2-3; collected in October, 1966. Specimens from Kaurpur mounted on slides MSJ/Tylenchorhynchus mujtabai/4-7.

Differential diagnosis: Tylenchorhynchus mujtabai n. sp., comes close to Tylenchorhynchus brassicae Siddiqi, 1961 but differs from it in having finely striated cuticle (2 μ apart in T. brassicae); punctations in the outer bands of lateral fields; number of labial striae (4 in T. brassicae); sloping spear knobs (directed upwards in T. brassicae); inner 2 incisures unite near the middle of tail and differently shaped spicules and gubernaculum.

The latest key to the species of the genus Tylenchorhynchus is by de Guiran (1967). The latter author has included 71 species in the key. Since then, several species of Tylenchorhynchus have been described: 4 Sturhan (1966) (3 of which were not included by de Guiran), one Geraert (1966), one Seshadri et al. (1967), 2 Chawla et al. (1968), 4 Sethi and Swarup (1968) and 6 Thorne and Malek (1968). In the present work, 2 new species have been added, while five known species which were regarded as valid by de Guiran (l.c.) have shown to be synonyms. The presentation of an emended key is therefore inevitable.

KEY TO SPECIES OF TYLENCHORHYNCHUS

1. Cuticle marked with both longitudinal and transverse striae.....2
   Cuticle marked with transverse striae only.....16
2. Striae form distinct squares on the cuticle.....3
   Striae do not form squares.....11

3. Lateral fields aerolated; phasmids large scutella-like .....mamillatus Tobar-Jimenez, 1966
Lateral fields not aerolated; phasmids of normal size. 4

4. Labial annules 2-4.....5
Labial annules 6-7.....7

5. Longitudinal striae 29; tail 1.7 anal body-widths long .....claytoni Steiner, 1937
Longitudinal striae less than 24; tail about 2.5 anal body-widths long.....6

6. Spear 20-22 µ; post-anal intestinal sac present..... .....stegus Thorne and Malek, 1968
Spear 13-15 µ; post-anal intestinal sac absent..... .....pachys Thorne and Malek, 1968

7. Tail terminus striated.....8
Tail terminus smooth.....9

8. Longitudinal striae 48, diminishing in posterior half of body.....tessellatus Goodey, 1952
Longitudinal striae 16, continue up to posterior extremity.....hexincisus n. sp.

9. Head sclerotization conspicuous; spear 24 µ..... .....tartuensis Krall, 1959
Head sclerotization inconspicuous; spear 18-22 µ....10

10. Longitudinal striae 30; tail cylindrical..... .....quadrifer Andrássy, 1954
Longitudinal striae 24; tail conical..... .....lenorus Brown, 1956

11. Longitudinal striae confined to esophageal region.....
.....brevilineatus Williams, 1960
Longitudinal striae extend up to tail region.....12
12. Tail terminus striated.....13
Tail terminus smooth.....14
13. Lip region continuous; spear 24-28 μ.....
.....lamelliferus (de Man, 1880) Filipjev, 1936
Lip region offset; spear 21 μ..judithae Andrassy, 1962
14. Female tail marked with 22 striae; bursa distally recurved.....phaseoli Sethi and Swarup, 1968
Female tail marked with 30-55 striae; bursa of normal shape.....15
15. Spear 24-27 μ.....microphasmis Loof, 1959
Spear 19-22 μ.....sulcatus de Guiran, 1967
16. Lateral lines 3-4.....17
Lateral lines 5-6.....54
17. Lateral lines 3.....18
Lateral lines 4.....23
18. Lip region offset.....19
Lip region continuous.....20
19. Spear 19-22 μ; tail striae 42-46.....
.....bifasciatus Andrassy, 1961
Spear 16-17 μ; tail striae 14-24.....
.....divittatus Siddiqi, 1961
20. Tail about 6 anal body-widths long; tail terminus striated.....rhopalocercus Seinhorst, 1963
Tail 2-3 anal body-widths long; tail terminus smooth..
.....21

21. Labial annules 4.....triglyphus Seinhorst, 1963
Labial annules 2-3.....22

22. Head sclerotization conspicuous; spear 22 μ.....
.....sculptus Seinhorst, 1963
Head sclerotization inconspicuous; spear 25-28 μ.....
.....chonai Sethi and Swarup, 1968

23. Tail terminus striated.....24
Tail terminus smooth.....33

24. Lip region offset.....25
Lip region continuous.....26

25. Labial annules 7; tail striae 46-48.....
.....dubius (Butschli, 1873) Filipjev, 1936
Labial annules 6; tail striae about 60.....
.....canalis Thorne and Malek, 1968

26. Spear 37-38 μ; tail about one anal body-width long....
.....brevicaudatus Hopper, 1959
Spear less than 30 μ; tail more than 2 anal body-widths long.....27

27. Labial annules 3; tail clavate, about 4 anal body-widths long.....clavicaudatus Seinhorst, 1963
Labial annules 4-7; tail not clavate, less than 3.5 anal body-widths long.....28

28. Head sclerotization conspicuous; spear 27-30 μ.....
.....magnicauda (Thorne, 1935) Filipjev, 1936
Head sclerotization inconspicuous; spear less than 24 μ.....29

29. Labial annules 4; tail conoid...*eremicolus* Allen, 1955
Labial annules 5-7; tail cylindrical or subcylindrical 30

30. Tail 2 anal body-widths long....*husingi* Paetzold, 1958
Tail more than 2.5 anal body-widths long.....31

31. Spear 17-18 μ.....*parvus* Allen, 1955
Spear 20-24 μ.....32

32. Body 1.0-1.4 mm.; labial annules 7; lateral fields not aerolated.....*maximus* Allen, 1955
Body 0.7-0.8 mm; labial annules 5-7; lateral fields aerolated.....*bryobius* Sturhan, 1966

33. Body 1.68 mm.; spear 31-39 μ..*galeatus* Litvinova, 1946
Body 1 mm. or less; spear less than 31 μ.....34

34. Lip region smooth.....*robustus* Thorne and Malek, 1968
Lip region bearing annules.....35

35. Labial annules 2.....36
Labial annules 3 or more.....37

36. Spear 19-23 μ.....*nudus* Allen, 1955
Spear 14-16 μ.....*delhiensis* Chawla et al., 1968

37. Tail hook-shaped with cuticular flaps.....
.....*bursifer* Loof, 1959
Tail conical, cylindrical or subcylindrical.....38

38. Lip region offset.....39
Lip region contimuous.....45

39. Spear 24-27 μ.....*cylindricus* Cobb, 1913
Spear less than 23 μ.....40

40. Post-anal intestinal sac present.....
.....goffarti Sturhan, 1966
Post-anal intestinal sac absent.....41

41. Tail 2.2 anal body-widths long, marked with 14-15 striae.....latus Allen, 1955
Tail more than 2.5 anal body-widths long, marked with more than 18 striae.....42

42. Spear 15-17 μ.....43
Spear 18-23 μ.....44

43. Lateral fields provided with two rows of punctations in addition to 4; cuticular striae about 1 μ apart....
.....mujtabai n. sp.
Lateral fields without rows of punctations; cuticular striae about 2 μ apart.....brassicae Siddiqi, 1961

44. Spear 20-23 μ; tail shape subcylindrical with hemispherical tip.....agri Ferris, 1963
Spear 18-20 μ; tail shape conical with bluntly pointed tip.....aduncus de Guiran, 1967

45. Spear 28-31 μ; tail striae 51-58.....
.....kegenicus Litvinova, 1946
Spear less than 26 μ; tail striae less than 40.....46

46. Body 0.8-1.0 mm.; spear 23-26 μ.....
.....silvaticus Ferris, 1963
Body less than 0.75 mm.; spear less than 22 μ.....47

47. Body ventrally contracted posterior to vulva.....
.....contractus Loof, 1964
Body not ventrally contracted posterior to vulva....48

48. Labial annules 3-4.....49
Labial annules 5-6.....51

49. Post-anal intestinal sac present...*ewingi* Hopper, 1959
Post-anal intestinal sac absent.....50

50. Males frequently found; spermatheca present.....
.....*mashhoodi* Siddiqi and Basir, 1959
Males never recorded; spermatheca absent.....
.....*martini* Fielding, 1956

51. Labial annules 6; tail striae 35-38.....
.....*manubriatus* Litvinova, 1946
Labial annules 5; tail striae less than 30.....52

52. Head sclerotization conspicuous; spear 21-22 μ.....
.....*ebriensis* Seinhorst, 1963
Head sclerotization inconspicuous; spear 15-17 μ....53

53. Tail striae 10-15.....*clarus* Allen, 1955
Tail striae 20-27.....*striatus* Allen, 1955

54. Lateral lines 5.....55
Lateral lines 6.....62

55. Tail terminus striated; spear 20-24 μ.....
.....*goodeyi* Marinari, 1962
Tail terminus smooth; spear 16-18 μ.....56

56. Labial annules 4-5.....57
Labial annules 6-8.....58

57. Body 0.48-0.63 mm.; lip region rounded; spermatheca absent.....*curvus* Williams, 1960
Body 0.8 mm.; lip region flat; spermatheca an elongate pouch, 2-3 body-widths long.....
.....*acutoides* Thorne and Malek, 1968

58. Basal esophageal bulb slightly overlaps the intestine 59

Basal esophageal bulb does not overlap the intestine.. 61

59. Tail about 2 anal body-widths long..*acutus* Allen, 1955

Tail about 3 anal body-widths long.....60

60. Tail striae 36-46; cardia inconspicuous..... .....*nilgriensis* Seshadri et al., 1967

Tail striae 23; cardia conspicuous..... .....*cacti* Chawla et al., 1968

61. Tail terminus bluntly pointed; tail striae 32-33..... .....*capitatus* Allen,1955

Tail terminus hemispherical; tail striae 42-53..... .....*acti* Hopper, 1959

62. Tail terminus striated.....63

Tail terminus smooth.....70

63. Lip region offset.....64

Lip region continuous.....65

64. Spear 21-23 µ; tail 2.8 anal body-widths long..... .....*bogdanovikatjkovi* (Kirjanova, 1941) Loof, 1959

Spear 23-27 µ; tail about 4 anal body-widths long..... .....*leptus* Allen, 1955

65. Spear more than 24 µ.....66

Spear less than 18 µ.....69

66. Head sclerotization conspicuous; spear 30-42 µ.....67

Head sclerotization inconspicuous; spear 24-27 µ....68

67. Body 0.8-1.1 mm.; tail striae 39-47.....
.....macrurus (Goodey, 1932) Filipjev, 1936
Body 1.4-2.0 mm.; tail striae 50-59.....
.....icarus Wallace and Greet, 1964

68. Body 0.6-0.8 mm.; labial annules 7; tail striae 53-58.
.....obscurus Allen, 1955
Body 0.89-0.92 mm.; labial annules 5-6; tail striae
35-39.....socialis Andrássy, 1962

69. Spear 12-15 µ; tail 3.8 anal body-widths long.....
.....nanus Allen, 1955
Spear 16-18 µ; tail about 3 anal body-widths long.....
.....nothus Allen, 1955

70. Lip region offset.....71
Lip region continuous.....78

71. Spear 67 µ; tail 1.3 anal body-widths long.....
.....superbus Allen, 1955
Spear less than 48 µ; tail more than 2 anal body-
widths long.....72

72. Spear more than 39 µ.....73
Spear less than 30 µ.....75

73. Labial annules 7; tail 2.6 anal body-widths long; tail
striae 34-37.....macrodens Allen, 1955
Labial annules 9; tail 3.5-3.7 anal body-widths long;
tail striae 49-58.....74

74. Head sclerotization conspicuous; tail subcylindrical..
.....alpinus Allen, 1955
Head sclerotization inconspicuous; tail conical.....
.....conicus Allen, 1955

75. Spear 25-30 µ.....76
Spear 15-22 µ.....77

76. Head sclerotization conspicuous; tail conical.....
.....grandis Allen, 1955
Head sclerotization inconspicuous; tail subcylindrical
.....lineatus Allen, 1955

77. Spear 22 µ; tail 4 anal body-widths long.....
.....obscurisulcatus Andrássy, 1959
Spear 15 µ; tail 2.5-3.0 anal body-widths long.....
.....microdorus Geraert, 1966

78. Tail 1.0-1.5 anal body-widths long; tail striae 10-12.
.....brachycephalus Litvinova, 1946
Tail more than 2 anal body-widths long; tail striae
more than 20.....79

79. Spear 14-16 µ.....brevidens Allen, 1955
Spear 20-36 µ.....80

80. Spear 20-22 µ.....81
Spear more than 26 µ.....82

81. Fourth annule of lip region divided into tiny blocks;
tail striae about 20....varians Thorne and Malek, 1968
Fourth annule of lip region not divided into blocks;
tail striae 49.....bavaricus Sturhan, 1966

82. Labial annules 8; spear 26-28 µ; tail striae 28-33....
.....affinis Allen, 1955
Labial annules 5-7; spear 28-36 µ; tail striae 39-52..
.....83

83. Head sclerotization conspicuous; hemizonid prominent..
.....hexagrammus Sturhan, 1966
Head sclerotization inconspicuous; hemizonid not seen.
.....berberidis Sethi and Swarup, 1968

SUBFAMILY TELOTYLENCHINAE Siddiqi, 1960

Siddiqi (1960) proposed Telotylenchinae to accommodate the genus Telotylenchus and Pseudhalenchus Tarjan, 1958. J.B. Goodey (1963) synonymised Telotylenchinae with Tylenchinae. Recently Allen and Sher (1967) consider it valid and include under it the genera: Telotylenchus, Carphodorus Colbran, 1960 and Trichotylenchus Whitehead, 1960.

GENUS TELOTYLENCHUS Siddiqi, 1960

Telotylenchus indicus was described by Siddiqi (1960). Since then the following 3 species have been added: Telotylenchus ventralis Loof, 1963; T. housei Raski et al., 1964 and T. whitei Fisher, 1965. Jairajpuri (1963) transferred Belonolaimus hastulatus Colbran, 1960 to Telotylenchus. Sauer (1966) placed Telotylenchus hastulatus and T. whitei under the genus Morulaimus Sauer, 1966.

Two populations of the genus Telotylenchus were collected from two different localities and both represent new species which are described below.

Telotylenchus historicus n. sp.

(Plate VIII)

Dimensions:

Females (19): L= 1.06 mm. (0.91-1.17 mm.); a= 44 (40-49); b*= 5.7 (5.3-6.5); c= 29 (25-35); V= 55 (50-63).

Female (holotype): L= 1.06 mm.; a= 42; b= 5.8; c= 33; V= 56.

Males (11): L= 1.01 mm. (0.91-1.08 mm.); a= 42 (40-45); b= 5.5 (5.0-6.2); c= 25 (22-29); T= 39 (33-42).

Description:

Female: Body straight, irregularly curved or 'C' shaped upon fixation and tapering gradually towards extremities. Cuticle marked with transverse striae, 1-2 μ apart. Lateral fields arise with two incisures near middle of spear, become three near dorsal esophageal gland opening and four near median esophageal bulb and continue with four incisures above the tail terminus. Width of lateral fields 1/4th-1/3rd the corresponding body-width. Lateral fields irregularly aerolated throughout the entire length, aerolations more distinct on female tail but could not be detected on male tail.

Head set off, flat at apex and marked with 8 minute distinct striae. Head framework faintly sclerotized. Spear 19-21 μ long, stout, anterior part (metenchium) 7-9 μ or 38-45% of spear length. Base of spear with three distinct

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b*= total length of body divided by length of esophagus to end of esophageal glands.

rounded, posteriorly sloping knobs, 4-5 μ wide. Esophagus typical. Valvular apparatus of the median esophageal bulb very large and distinct. Three esophageal glands form a compact lobe with conoid to rounded terminus, overlapping the intestine for about 1½ times the body-width at junction with the intestine. Orifice of dorsal esophageal gland 2-3 μ from base of spear. Nerve ring around middle of isthmus. Excretory pore near middle or anterior to middle of the esophageal gland lobe. Hemizonid 2-4 striae long, situated 3-7 striae above the excretory pore. Deirids at level of excretory pore.

Vulva a transverse slit. Gonads amphidelphic, outstretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca large, spherical filled with sperms. Tail cylindrical with irregularly indented terminus (rarely with flat terminus), 1.5-over 2 anal body-widths long. Phasmids near middle of tail.

Male: Similar to female in general morphology. Testis single, outstretched. Spicules slightly arcuate, 24-25 μ long medially. Gubernaculum 10-12 μ long, proximal end bent posteriad. Bursa well developed with crenate margins. Anus with protruding lips. Phasmids near middle of tail.

Habitat: Soil around roots of Hibiscus cannabinus, near to the Ajanta caves, Maharashtra.

Type specimens: Collected in August, 1966. Holotype female and one paratype male on slide MSJ/Telotylenchus

historicus/1; paratypes on slides MSJ/Telotylenchus historicus/2-6.

Differential diagnosis: Telotylenchus historicus n. sp., comes closest to T. housei Raski, Prasad and Swarup, 1964 but differs in the character of lateral fields, length of spear and shapes of lip region and tail terminus.

Telotylenchus aerolatus n. sp.

(Plate: IX)

Dimensions:

Females (3): L= 0.71-0.80 mm.; a= 34-38; b= 4.4-5.7; c= 15-19; V= 52-55.

Female (holotype): L= 0.84 mm.; a= 35; b= 5.1; c= 14; V= 51.

Males (4): L= 0.67-0.73 mm.; a= 33-37; b= 4.3-4.6; c= 12-16; T= 47-55.

Description:

Female: Body slightly curved in posterior half of its length or often 'C' shaped upon fixation and tapering slightly towards extremities. Cuticle marked with distinct transverse striae about 1 μ apart. Longitudinal striations absent. Lateral fields originate with two incisures near base of spear, become three near middle of procorpus and four slightly below the median esophageal bulb. These four incisures continue slightly below the phasmids on tail, then the inner two incisures fuse together and the remaining three incisures

continue up to the tail terminus. Outer incisures are crenate while the inner slightly irregularly wavy. Width of lateral fields 1/4th-1/3rd of body-width near middle. Lateral fields irregularly aerolated throughout the length of incisures.

Lip region well set off, flat at apex, marked by 8-9 striae. Head framework sclerotized. Spear 16-18 μ long, stout, anterior part (metenchium) 7-8 μ or 43-44% of spear length. Base of spear with three large and rounded posteriorly sloping knobs, about 4 μ wide. Esophagus consists of a long cylindrical procorpus, a median esophageal bulb and a posterior esophageal gland lobe. Median esophageal bulb ovate, 14-15 μ long and 9-10 μ wide and with very distinct valvular apparatus in the centre. The three esophageal glands form a compact lobe, overlapping the intestine for about 2 body-widths. Orifice of the dorsal esophageal gland 1-2 μ from spear base. Nerve ring 89-104 μ from anterior end, along middle of isthmus. Excretory pore 104-114 μ from anterior end, opposite the junction of esophageal gland lobe with intestine. Hemizonid 2-3 striae long, situated 1-7 striae above the excretory pore. Deirids at level of hemizonid.

Vulva a transverse slit. Vagina 10-12 μ across the body, about 1/2 the corresponding body-width. Gonads amphidelphic, outstretched. Each sexual branch consists of an ovary, oviduct, spermatheca and uterus. Spermatheca large, spherical, filled with sperms. Tail elongate, cylindrical with rounded

smooth terminus, marked with 31-37 striae and 2.9-3.7 anal body-widths long. Phasmids in anterior third of tail.

Male: Similar to female in general morphology. Testis single, outstretched. Spicules slightly arcuate, 22-24 μ long medially. Gubernaculum 11-13 μ long, proximal end knobbed. Bursa well developed with crenate margins. The four incisures of lateral fields gradually expand on tail end and faint away. Only the outer incisure of the dorsal side reaches beyond phasmids, the other three disappear at or above level of anus. Anus with protruding lips. Phasmids near middle of tail. Tail elongate-conoid, 2.5-3.0 anal body-widths long.

Habitat: Soil around roots of Crotalaria juncea from Barwe Sagar, district Jhansi, U.P.

Type specimens: Collected in October, 1967. Holotype female mounted on slide MSJ/Telotylenchus aerolatus/1; paratypes on slides MSJ/Telotylenchus aerolatus/2-4.

Differential diagnosis: Telotylenchus aerolatus n. sp., comes closest to T. indicus Siddiqi, 1960 and T. ventralis Loof, 1963. From the former it differs in having a longer esophagus, larger number of striae on the lip region, orifice of dorsal esophageal gland close to spear base, prominent hemizonid, metenchium shorter then posterior cylindrical shaft of the spear, posteriorly sloping spear knobs and differently shaped spicules. From T. ventralis it differs in having

longer esophagus, no expansion and contraction of body near vulva, differently shaped and shorter spicules. From both these species it can also be separated in having aerolated lateral fields, inner incisures wavy and in the manner of termination of incisures on female tail.

KEY TO SPECIES OF TELOTYLENCHUS

1. Lip region continuous.....*housei* Raski et al., 1964
   Lip region set off by a deep constriction.....2
2. Female body ventrally expanded then contracted near vulva.....*ventralis* Loof, 1963
   Female body not ventrally expanded and contracted near vulva.....3
3. Tail terminus broad and striated.....*historicus* n. sp.
   Tail terminus narrow and smooth.....4
4. Lateral fields aerolated; metenchium 44%.....
   .....*aerolatus* n. sp.
   Lateral fields not aerolated; metenchium 50%.....
   .....*indicus* Siddiqi, 1960

FAMILY HOPLOLAIMIDAE (Filipjev, 1934) Wieser, 1953

A large number of nematodes belonging to the following 6 genera of the family Hoplolaimidae was collected during the investigations: Hoplolaimus Daday, 1905; Helicotylenchus Steiner, 1945; Rotylenchus Filipjev, 1936; Hirschmanniella Luc and Goodey, 1963; and Rotylenchulus Linford and Oliveira, 1940. These nematodes are classified into 10 species: One Hoplolaimus, 6 Helicotylenchus, one Pratylenchus, one Hirschmanniella and one Rotylenchulus. Helicotylenchus egyptiensis and H. pseudorobustus are here recorded for the first time from India. The species of Hoplolaimus, Helicotylenchus and Pratylenchus are widely distributed in Uttar Pradesh while of the other genera are rare. Specific identification of Rotylenchus specimens was not possible.

SUBFAMILY HOPLOLAIMINAE Filipjev, 1934

GENUS HOPLOLAIMUS Daday, 1905

Hoplolaimus indicus Sher, 1963

Nearly 95% of the soil samples contained specimens of this species. They were found associated with all the five species of fibrous plants which were investigated. The species was recorded from various localities of Agra, Aligarh, Allahabad, Badaun, Banaras, Bijnor, Bulandshahr, Etah, Etawah, Ghazipur, Jalaun, Jhansi, Kanpur, Mainpuri, Mathura, Meerut,

Mirzapur, Moradabad, Muzaffarnagar, Rampur, Saharanpur and Shahjahanpur districts of Uttar Pradesh.

GENUS HELICOTYLENCHUS Steiner, 1945

Helicotylenchus erythrinae (Zimmermann, 1904) Golden, 1956

Habitat: Several females from Hibiscus cannabinus from Banaras and Jhansi districts, U.P.

Helicotylenchus pseudorobustus (Steiner, 1914) Golden, 1956

Habitat: Eight females from Gossypium herbaceum from Deoband, district Saharanpur, U.P.

Helicotylenchus indicus Siddiqi, 1963

Habitats: i) More than one hundred females from Gossypium hirsutum from Aligarh, U.P.

ii) Several hundred females from soil around roots of Gossypium herbaceum from Agra, Allahabad, Bijnor, Badaun, Etah, Etawah, Mainpuri, Mathura, Meerut, Muzaffarnagar, Rampur and Saharanpur districts of Uttar Pradesh.

iii) Ten females from Gossypium arboreum from Kanpur district, U.P.

iv) Over 2 hundred females from Crotalaria juncea from Banaras, Jalaun, Jhansi, Ghazipur, Kanpur and Shahjahanpur districts of U.P.

Helicotylenchus retusus Siddiqi and Brown, 1964

Habitats: i) Seventeen females from Gossypium hirsutum from Aligarh, U.P.

ii) Several hundred females from Gossypium herbaceum from Bulandshahr, Etah, Kanpur, Meerut, Moradabad and Saharanpur districts of Uttar Pradesh.

iii) Several females from Crotalaria juncea from Jhansi and Kanpur districts of U.P.

iv) Seven females from Hibiscus cannabinus from Jhansi, U.P.

Helicotylenchus digitatus Siddiqi and Husain, 1964

Habitats: i) About one hundred females from Gossypium herbaceum from Muzaffarnagar and Meerut districts of U.P.

ii) Seven females from Gossypium arboreum from Bulandshahr district, U.P.

Helicotylenchus egyptiensis Tarjan, 1964

Habitats: i) Several females from Gossypium arboreum from Bijnor district, U.P.

ii) Forty six females from Crotalaria juncea from Jhansi and Mirzapur districts of U.P.

SUBFAMILY PRATYLENCHINAE Thorne, 1949

GENUS PRATYLENCHUS Filipjev, 1936

Pratylenchus thornei Sher and Allen, 1953

This species of the genus Pratylenchus is widely distributed around the roots of fibrous crops in Uttar Pradesh.

Habitats: A large number of female specimens was collected from Gossypium hirsutum, Gossypium herbaceum, Gossypium arboreum, Crotalaria juncea and Hibiscus cannabinus from various localities of Aligarh, Allahabad, Banaras, Bulandshahr, Etah, Etawah, Jalaun, Jhansi, Kanpur, Mainpuri, Mathura, Meerut, Mirzapur, Moradabad, Muzaffarnagar, Rampur, Saharanpur and Shahjahanpur districts.

GENUS HIRSCHMANNIELLA Luc and Goodey, 1963

Hirschmanniella oryzae (Soltwedel, 1889) Luc and Goodey, 1963

Habitat: Twentyfive females and males were collected from soil around roots of Crotalaria juncea from Jalaun and Kanpur districts of U.P.

SUBFAMILY ROTYLENCHULINAE Husain and Khan, 1967

GENUS ROTYLENCHULUS Linford and Oliveira, 1940

Rotylenchulus reniformis Linford and Oliveira, 1940

Habitat: Several hundred females(immature) and males from Gossypium herbaceum from Muzaffarnagar and Meerut districts, U.P.

FAMILY NEOTYLENCHIDAE (Thorne, 1941) Thorne, 1949

SUBFAMILY NOTHOTYLENCHINAE Thorne, 1941

GENUS DORSELLA Jairajpuri, 1966

Dorsella indica Jairajpuri, 1966

Habitat: Three females from soil around roots of Gossypium herbaceum from Aligarh, U.P.

SUPERFAMILY CRICONEMATOIDEA (Taylor, 1936) Geraert, 1966

FAMILY HEMICYCLIOPHORIDAE (Skarbilovich, 1959) Geraert, 1966

SUBFAMILY HEMICYCLIOPHORINAE Skarbilovich, 1959

GENUS HEMICYCLIOPHORA de Man, 1921

Hemicycliophora eugeniae Khan and Basir, 1963

Habitat: Eight females from Gossypium herbaceum from Isapur, district Meerut, U.P.

SUPERFAMILY APHELENCHOIDEA (Fuchs, 1937) Thorne, 1949

FAMILY APHELENCHIDAE (Fuchs, 1937) Steiner, 1949

SUBFAMILY APHELENCHINAE (Fuchs, 1937) Schuurmans Stekhoven and Teunissen, 1938

GENUS APHELENCHUS Bastian, 1865

Aphelenchus avenae Bastian, 1865.

This species is widely distributed in Uttar Pradesh. Several hundred females but only a few males were found from soil around roots of all the five species of fibrous crops from the following districts: Agra, Aligarh, Allahabad, Badaun, Banaras, Bijnor, Bulandshahr, Etah, Etawah, Ghazipur, Jalaun, Jhansi, Kanpur, Mainpuri, Mathura, Meerut, Mirzapur, Moradabad, Muzaffarnagar, Rampur, Saharanpur and Shahjahanpur.

ORDER DORYLAIMIDA (DE MAN, 1876) PEARSE, 1942

SUPERFAMILY DORYLAIMOIDEA (de Man, 1876) Thorne, 1934

FAMILY DORYLAIMIDAE de Man, 1876

The nematodes of the family Dorylaimidae obtained during the present study belong to a new genus Willinema and to the following 8 genera: Dorylaimus Dujardin, 1845; Eudorylaimus Andrássy, 1959; Mesodorylaimus Andrássy, 1959; Labronema Thorne, 1939; Thornenema Andrássy, 1959; Pungentus Thorne and Swanger, 1936; Discolaimus Cobb, 1913 and Discolaimium Thorne, 1939. Six new species; one Willinema, one Pungentus, and 4 Discolaimium were recorded. Males of Thornenema baldum (Thorne, 1939) Andrássy, 1959 are reported for the first time in the genus. Specific identification of the specimens of Dorylaimus, Eudorylaimus, Mesodorylaimus and Labronema was not done.

GENUS THORNENEMA Andrássy, 1959

Andrássy (1959) proposed the genus Thornenema for the following species of Dorylaimus Dujardin, 1845 which possess narrow, amalgamated lip region, mono-opisthodelphic gonad and long filiform tail: D. lissus Thorne, 1939; D. limnophilus de Man, 1880; D. laevicapitatus Cobb in Thorne and Swanger, 1936; D. thienemanni W. Schneider, 1937; D. baldus Thorne,1939

and D. cavalcantii Lordello, 1955. In 1960 he also included Dorylaimus sylphoides Williams, 1959 in this genus. Williams (1964) described a new species, T. viriosum, redescribed T. baldum and T. sylphoides and also transferred Labronema parvum Williams, 1959 into Thornenema because of its narrow, amalgamated lip region and mono-opisthodelphic gonad. Loof (1964) redescribed T. cavalcantii from Venezuela and transferred T. limnophilum to the genus Dorylaimoides Thorne and Swanger, 1936. Loof (l.c.) also described Thornenema spec. 1 & 2 which can not be regarded as species of Thornenema because of their lip region and tail shapes. Siddiqi (1965) added two new species: T. filiforme and T. paradoxum and also reported T. cavalcantii from India. Prasad and Chawla (1965) described T. delhiense (delhiensis emended) from New Delhi, India. Andrássy (1965) described T. africanum from Ghana and also transferred T. limnophilum to Dorylaimoides and T. parvum to Eudorylaimus Andrássy, 1959. Jairajpuri (1966) amplified the description of T. thienemanni from specimens collected in India. This species was earlier considered as species inquirenda by Siddiqi (1965) because inadequate information was available on its morphology.

A large number of specimens of Thornenema was collected in recent years. They represent the species: T. baldum and T. mauritianum (Williams, 1959) n. comb. (syn. Chrysonema mauritiana Williams, 1959). Thornenema baldum was found near Tuticorin, Kurnool and Bombay. The Tuticorin population also includes two males which are reported here for the first time

in this genus. Thornenema mauritianum has been collected from various localities during the investigation.

Andrássy (1965) did not agree with Williams (1964) and considered Labronema parvum under the genus Eudorylaimus. However, this species certainly does not belong in Eudorylaimus because of its narrow, amalgamated lip region, mono-opisthodelphic gonad and rounded tail. The inclusion of Labronema parvum in Thornenema also is not justified because of the tail shape. A study of the paratypes of Labronema parvum obtained through the courtesy of Mr. David J. Hooper of Rothamsted Experimental Station, Harpenden, England, and of a similar species collected in India indicate that they constitute a distinct group Willinema* n. gen.

Thornenema baldum (Thorne, 1939) Andrássy, 1959

(Plates: X & XI)

syn. Thornenema paradoxum Siddiqi, 1965

Dimensions: See Table II.

Description:

Female: Body cylindroid, tapering gradually anterior to slender part of esophagus, slightly curved in posterior third of its length in Tuticorin population, curved posterior to itsvulva in Kurnool population and curved in the posterior half of its length in Bombay population. Cuticle smooth, its thickness varies between 1-6 μ at various places in the body.

*Named after Dr. J.R. Williams, Sugar Industry Research Institute, Reduit, Mauritius.

Subcuticle with faint striations, less than 1 μ thick. Lip region narrow, truncated, amalgamated and strongly sclerotized. Its width about one-fourth the body-width at the base of esophagus and offset from the body by a depression. In Kurnool population the lip region is not so truncated and marked off. Just below the lip region there are characterstic buldges in the tissues as pointed out by Williams (1964). Labial papillae visible. Lateral chords one-sixth to one-fifth body-width near middle of body. Lateral body pores not seen. Amphids cup-shaped; their apertures about half the corresponding body-width, situated about 5-6 μ from anterior end. Sensillar pouches 17-19 μ from amphidial apertures.

Spear cylindrical; 11-13 μ long (12-14 μ long according to Williams, 1964); aperture occupying about one-fourth or more of spear length. Spear extensions 17-19 μ, simple, nearly one and a half times the length of the spear. Guiding ring single but may appear double in some specimens, the fixed ring 7-8 μ from the anterior end of the body. Esophagus consists of an anterior slender part gradually expanding to form the basal expanded portion which occupies one-third or more of the total esophageal length (about one-half according to Thorne, 1939). The slender part narrowing slightly as it passes through the nerve ring. Expanded portion has a wide esophageal lumen, occupying about one-seventh to one-fifth of its width. Width of expanded portion about half or less of the body-width at base of esophagus and one-fifth to one-fourth of its own length. Opening of dorsal esophageal gland

123-170 μ or 61-68% of the esophageal length from the anterior end. The first pair of subventral esophageal glands open 27-32 μ from the dorsal esophageal gland opening; the second pair opens 17-20 μ below the opening of the first pair. Nerve ring 80-90 μ from the anterior end. Cardia rounded (cylindroid according to Thorne, 1939 and conoid according to Williams, 1964).

Vulva a transverse slit. Vagina 15-19 μ long or one-half to one-third the body-width, bent slightly posteriorly. Gonad mono-opisthodelphic. Anterior uterine sac rudimentary, 8-12 μ or about one-fifth to one-third the body-width long. Ovary reflexed, one-half to two-thirds way back to vulva. Oviduct and uterus not distinctly separated, their combined length 128-180 μ. Oocytes arranged in a single row except at the tip of ovary. Eggs 79-86 x 26-28 μ. Prerectum 35-48 μ, about twice the anal body-width. Rectum 21-26 μ, about one anal body-width long. Tail at first slightly convex-conoid then filiform to the terminus; length 5-9 times the anal body-width. Tail tip acute or finely or smoothly rounded. Two pairs of minute caudal pores present.

Male: Adanal pair of supplements and six ventromedians arranged at irregular intervals; first ventromedian supplement a little above the range of the spicules. Spicules 28 μ long medially. Tail conoid, about equal to anal body-width. Cuticle 6-7 μ thick on tail.

Habitats: Tuticorin population: Soil around roots of guava, Psidium guajava from Tuticorin, Madras State.

Kurnool population: Soil around roots of groundnuts from Kurnool, Andhra Pradesh.

Bombay population: Soil around roots of Gossypium sp. from Bombay, Maharashtra.

Relationship: Thornenema baldum is closely related to T. mauritianum but differs in having a comparatively smaller body; offset, flat and strongly sclerotized lip region with characterstic buldges in the tissues below it; wide esophageal lumen; slender part of esophagus narrowing as it passes through the nerve ring; presence of a rudimentary anterior uterine sac and smaller eggs.

Discussion: Siddiqi (1965) mentioned the following three characters to distinguish Thornenema paradoxum from T. baldum: Expanded part of esophagus measuring less than half the esophageal length in T. paradoxum but about one-half in T. baldum; vulva located at six body-widths behind the base of esophagus in T. paradoxum and at three in T. baldum and the "absence" of anterior uterine sac in T. paradoxum and its presence in T. baldum. When compared with the dimensions and description of T. baldum as given by Williams (1964) and as above, T. paradoxum, whose description is based on a single female, can not be regarded as a valid species for the following reasons: The population of T. baldum described by Williams (1964) as well as the present specimens have an esophagus in which the expanded

T A B L E II

Thornenema baldum

Population	No. of specimens	Length in mm.	a	b	c	V/T
TUTICORIN	10 (♀♀)	1.01	30	5.1	9	34^{14}
		(0.99-1.04)	(29-31)	(4.7-5.6)	(7-10)	$(30\text{-}37^{9\text{-}16})$
	2 (♂♂)	0.84-0.89	26-29	4.2-5.1	32-35	57-59
KURNOOL	8 (♀♀)	1.01	28	5.0	6	35^{11}
		(0.93-1.07)	(24-30)	(4.7-5.7)	(6-7)	$(33\text{-}36^{9\text{-}12})$
BOMBAY	5 (♀♀)	0.93-1.00	28-32	4.8-5.0	6-8	$32\text{-}35^{10\text{-}12}$
Thorne, 1939	1 (♀)	1.00	31	4.7	6	33^{12}
Williams, 1964	5 (♀♀)	1.00	30	5.1	7	34
		(0.97-1.04)	(28-32)	(4.7-5.4)	(7-8)	(32-36)
Siddiqi, 1965 (of T. paradoxum)	1 (♀)	1.32	36	5.3	9	35

part occupies less than half to about one-third of the total esophageal length. In some specimens of the Indian populations of T. baldum, the vulva is up to six body-widths behind the base of the esophagus. As regards the "absence" of anterior uterine sac, Siddiqi has himself clearly said in the description of T. paradoxum "anterior uterine sac rudimentary, less than half body-width". Thornenema paradoxum is therefore considered a synonym of T. baldum.

Thornenema mauritianum (Williams, 1959) n. comb.

(Plates: XII & XIII)

syn. Thornenema viriosum Williams, 1964
T. filiforme Siddiqi, 1965
T. delhiensis Prasad and Chawla, 1965
T. africanum Andrássy, 1965
Chrysonema mauritiana Williams, 1959

Dimensions: See Table III.

Description:

Female: Body cylindroid, gradually tapering anterior to slender part of esophagus; slightly curved in Aligarh populations while in the Kurnool and Andamans populations it is curved only in the posterior half of the body. Cuticle smooth, its thickness varies between 1-3 μ at various places in the body. Subcuticle with faint striations, less than 1 μ thick. Lip region narrow, amalgamated, rounded, lightly sclerotized, only very slightly set off from body; width of

lip region about one-fourth the width of body at base of esophagus. Labial papillae visible. Lateral chords granular, one-seventh to one-fifth the body-width at base of esophagus, 5-7 μ wide. Lateral body pores not seen. Amphids somewhat stirrup-shaped; amphidial slits 5-6 μ wide, about one-half the corresponding body-width and 5-6 μ from anterior end. Sensillar pouches 18-20 μ below the amphidial slits.

Spear 11-13 μ long, cylindrical; aperture 3-5 μ or one-fourth to one-third of spear length. Spear extensions simple, straight or slightly curved with wide lumen, 15-18 μ long or about one and a half times the spear length. Guiding ring apparently double in most of specimens, 6-8 μ from anterior end. Slender part of esophagus does not narrow as it passes through nerve ring. Basal expanded portion of esophagus 38-46% of total esophageal length; width about one-half of body-width at base of esophagus and one-seventh to one-fifth of its own length. Esophageal lumen one-eighth to one-seventh of width of basal expanded portion. Opening of dorsal esophageal gland 144-188 μ or 55-65% of the esophageal length from the anterior end. The first pair of subventral esophageal glands open 25-42 μ from the dorsal esophageal gland opening; the second pair 16-31 μ below the opening of the first pair. Nerve ring 90-110 μ from anterior end. Cardia somewhat conoid to mammiform.

Vulva transverse. Vagina 13-17 μ long, extending less than one-half across the body. Gonad mono-opisthodelphic.

Combined length of oviduct and uterus 89-210 µ. No sperms in uterus. Eggs 126-138 x 24-26 µ. Anterior sexual branch absent. Prerectum 42-63 µ long, two to three times the anal body-width. Rectum 22-33 µ long, one to one and a half times the anal body-width. In some specimens tail is elongate-conoid and only 4-6 anal body-widths long with bluntly rounded terminus; in others it is 6-8 anal body-widths long with clavate or rounded terminus. In most specimens tail is 10-14 anal body-widths long, filiform with smoothly rounded terminus. Length of tail varies between 80-279 µ. Two caudal pores present. Tubular organs extending into intestine lumen from prerectum described by Williams (1959) for Chrysonema maritiana and by Andrássy (1965) for Thornenema africanum faintly visible in some specimens of the present populations.

Habitats: Naqvi park, Aligarh population: Soil around roots of Canna sp. and Hordeum vulgare from Aligarh, U.P.

Zoology Department, Aligarh population: Soil around roots of Gossypium hirsutum from Aligarh, U.P.

Kurnool population: Soil around roots of groundnuts from Kurnool, Andhra Pradesh.

Andamans population: Soil around roots of papaya, Carica papaya from Andamans.

Mathura population: Soil around roots of Gossypium hirsutum from Kisera, Mathura, U.P.

Aurangabad population: Soil around roots of mosses, Funaria sp. from Aurangabad, Maharashtra.

Additional localities: Several specimens were also collected from Badaun, Bijnor, Bulandshahr, Etah, Etawah, Meerut, Muzaffarnagar, and Saharanpur districts of U.P.

Relationship: Thornenema mauritianum is closest to T. baldum, T. lissum and T. sylphoides. The characters distinguishing T. mauritianum from T. baldum have already been given. From T. lissum it differs in having a comparatively more sclerotized lip region, shape of amphids and absence of the anterior uterine branch. From T. sylphoides it is differentiated by its small and differently shaped tail and transverse vulva (vulva circular in T. sylphoides).

Discussions: The species, Thornenema mauritianum was originally described by Williams (1959) in the genus Chrysonema Thorne, 1929. From Williams descriptions and illustrations it is quite evident that it has more resemblance to the genus Thornenema in having a narrow, amalgamated and sclerotized lip region and mono-opisthodelphic gonad. A paratype specimen of C. mauritiana was kindly supplied by Mr. David J. Hooper and a study of this specimen confirmed that the species certainly belongs in the genus Thornenema. Some paratypes of T. viriosum sent by Mr. Hooper were also examined and found to be identical with T. mauritianum. Thornenema viriosum is therefore regarded as synonym of T. mauritianum.

Thornenema filiforme, T. delhiense and T. africanum are closely related to each other and are also very similar

to T. mauritianum. Thornenema filiforme falls well within the dimensions and description of T. mauritianum as given above and is therefore regarded as its synonym. The type specimens of T. delhiense obtained through the courtesy of Dr. S.K. Prasad, I.A.R.I., New Delhi and also specimens of this species collected from the type locality do not show the knobbed spear extensions, cylindroid esophagus and three pairs of caudal papillae as illustrated and described by Prasad and Chawla (1965). These specimens also fit perfectly well with T. mauritianum and are its synonym. Similarly, there are no valid characters to separate T. africanum from T. mauritianum and it should be regarded as a synonym.

GENUS THORNENEMA Andrássy, 1959

Diagnosis (emended): Dorylaiminae. Lip region narrow, amalgamated and sclerotized. Spear cylindrical; spear extension simple, hollow rod-like; spear guiding ring appearing single or double. Basal expanded portion of esophagus one-third to half of the total esophageal length. Vulva pre-equatorial. Female gonad mono-opisthodelphic. Supplements consist of an adanal pair and a non-contiguous ventromedian series. Tail different in the two sexes, elongate-conoid with a filiform terminus in female and short bluntly-conoid in males.

Type species: Thornenema lissum (Thorne, 1939) Andrássy, 1959

Relationship: The genus Thornenema is very close to the genus Mesodorylaimus Andrássy, 1959 but can be differentiated in having narrow, amalgamated, sclerotized lip region and mono-opisthodelphic gonad.

KEY TO THE SPECIES OF THORNENEMA

1. Spear length twice the head-width; tail constricted on both the sides behind the anus.....laevicapitatum
   Spear length less than two head-widths; tail unconstricted or constricted only on dorsal side.....2
2. Vulva at more than 40%; tail constricted on dorsal side .....cavalcantii
   Vulva at less than 40%; tail unconstricted.....3
3. Amphids twice as long as wide.....lissum
   Amphids about as long as wide.....4
4. c= less than 4; vulva circular.....sylphoides
   c= more than 5; vulva transverse.....5
5. Body length less than 0.7 mm.; spear 9 µ....thienemanni
   Body length more than 0.8 mm.; spear more than 10 µ...6
6. Head strongly sclerotized, truncated; anterior uterine sac present.....baldum
   Head not strongly sclerotized, rounded; anterior uterine sac absent.....mauritianum

T A B L E III

Thornenema mauritianum

Population	No. of specimens	Length in mm.	a	b	c	V
NAQVI PARK, ALIGARH	100 (♀♀)	1.51 (1.20-1.72)	41 (31-48)	5.4 (4.2-6.0)	7 (5-16)	33^{9}_{7-13} (29-38)
ZOOLOGY DEPT., ALIGARH	25 (♀♀)	1.42 (1.30-1.55)	43 (38-48)	5.7 (4.4-6.6)	6 (5-10)	32^{11}_{7-15} (30-35)
KURNOOL	6 (♀♀)	1.46 (1.40-1.60)	46 (43-49)	5.4 (5.1-5.7)	8 (7-8)	34^{8}_{7-10} (32-35)
ANDAMANS	8 (♀♀)	1.56 (1.30-1.60)	44 (43-48)	5.0 (4.1-5.3)	6 (5-9)	31^{9}_{8-14} (30-35)
MATHURA	4 (♀♀)	1.46-1.70	43-45	5.5-5.9	6-7	$32-34^{7-12}$
AURANGABAD	1 (♀)	1.40	36	5.0	8	33^{8}
Williams, 1959 (*C. mauritiana*)	4 (♀♀)	1.40 (1.00-1.60)	34 (25-39)	4.8 (4.6-5.3)	7 (7-8)	34^{9} (33-36)

TABLE III (Contd.)

Population	No. of specimens	Length in mm.	a	b	c	V
Williams, 1964 (T. viriosum)	5 (♀♀)	1.60 (1.54-1.70)	41 (40-46)	5.3 (5.2-5.8)	8 (7-9)	34 (32-35)
Siddiqi, 1965 (T. filiforme) Cuddalore	4 (♀♀)	1.34-1.60	46-52	4.7-5.8	5	31-32
Siddiqi, 1965 (T. filiforme) Vangaon	1 (♀)	1.67	43	5.1	6	33
Siddiqi, 1965 (T. filiforme) Aligarh	1 (♀)	1.51	41	5.2	6	32
Prasad & Chawla, 1965 (T. delhiense)	10 (♀♀)	1.63-2.01	40-49	5.4-6.7	6-7	29-34
Andrássy, 1965 (T. africanum)	2 (♀♀)	1.50-2.00	40-49	5.4-6.7	6-7	28-37

GENUS WILLINEMA n. gen.

Diagnosis: Dorylaiminae. Same as Thornenema. Tail hemispheroid. Males unknown.

Type species: Willinema parvum (Williams, 1959) n. comb.

syn. Labronema parvum Williams, 1959

Thornenema parvum (Williams, 1959) Williams, 1964

Other species: W. indicum n. sp.

Relationship: The genus Willinema is closely related to Mesodorylaimus, Thornenema and Labronema. From Mesodorylaimus it differs in the form of the lip region, in having monoopisthodelphic gonad and rounded tail. From Thornenema it differs mainly in the shape of female tail. Although male of Willinema is not known but there could be only two possibilities as regards the shape of its tail: It may be either similar to its female tail, i.e., hemispheroid or it may be dissimilar. In both these cases Thornenema and Willinema could easily be separated on tail shapes. From Labronema it can be differentiated in the shape of lip region and number of gonads. Willinema has some superficial resemblance to Thorneella Andrássy, 1960 but differs clearly in the shape of amphids, lip region and gonads.

KEY TO MESODORYLAIMUS, THORNENEMA, WILLINEMA AND LABRONEMA

1. Female tail rounded.....2

   Female tail elongate-conoid with a long filiform terminus.....3

2. Lip region narrow, amalgamated and sclerotized; ovary single.....Willinema

   Lip region not sclerotized, prominent with six inarching lip flaps; ovaries paired.....Labronema

3. Lip region narrow, amalgamated and sclerotized; ovary single.....Thornenema

   Lip region not so narrow and amalgamated and unsclerotized; ovaries paired.....Mesodorylaimus

Willinema indicum n. sp.

(Plate: XIV)

Dimensions:

Females (16): L= 0.83 mm. (0.76-0.90 mm.); a= 33 (28-37); b= 5.0 (4.0-5.7); c= 44 (41-50); $V = 48^{13}_{(45-52)}$ $^{10-17}$.

Female (holotype): L= 0.87 mm.; a= 35; b= 5.2; c= 44; $V = 49^{13}$.

Description:

Female: Body cylindroid, tapering gradually anterior to slender part of esophagus. Cuticle smooth, its thickness varies between 1-6 μ at various places in the body. Subcuticle with faint striations, less than 1 μ thick. Lip region narrow, amalgamated, slightly set off by a depression and about one-fourth the body-width at base of esophagus. Labial papillae visible, but do not modify contour of lip region. Lateral chords distinct, vacuolated and one-sixth to one-fifth of body-width near middle. Amphids cup-like, their apertures occupying more than one half the corresponding body-width,

4-5 μ from anterior end. Sensillar pouches 16-17 μ from amphidial slits.

Spear 9-11 μ, cylindrical; aperture occupying more than one-fourth of spear length. Guiding ring 6-7 u from anterior end, single. Spear extensions 14-16 μ long, simple. Basal expanded portion of esophagus occupies about one-third of total esophageal length. Width of basal expanded portion about two-thirds of body-width at base of esophagus and about one-fourth of its own length. Opening of dorsal esophageal gland 98-118 μ or 65-68% of the esophageal length from the anterior end. The first pair of subventral esophageal glands open 26-28 μ behind the dorsal esophageal gland opening; the second pair opens 11-13 μ behind the opening of the first pair. Nerve ring 76-86 μ from the anterior end. Cardia hemispheroid.

Vulva a transverse slit. Vagina 11-14 μ, about one-half the body-width long. Combined length of uterus and oviduct 100-158 μ. Ovary with flexure. Anterior uterine branch about half the corresponding body-width long. Oocytes arranged in a single row, except at tip of ovary. Prerectum 35-54 μ or two to three anal body-widths. Rectum 18-22 μ long, about one anal body-width. Tail hemispheroid, about one anal body-width long. Two minute caudal pores present.

Males: Not found.

Habitat: Soil around roots of Gossypium sp. from Tuticorin, Madras State.

Type specimens: Collected in 1965; holotype mounted on slide MSJ/Willinema indicum/1; 16 paratypes on slides MSJ/Willinema indicum/2-5.

Differential diagnosis: Willinema indicum n. sp., differs from W. parvum in having a shorter body, narrower lip region, smaller spear and spear extensions (spear and spear extensions each 14-15 μ long in W. parvum), single guiding ring (double guiding ring in W. parvum), a shorter esophagus (b= 3.5-4.0 in W. parvum), the basal expanded portion of esophagus occupying only one-third or less of the total esophageal length (one-half in W. parvum).

GENUS PUNGENTUS Thorne and Swanger, 1936

Pungentus angulatus n. sp.

(Plate: XV)

Dimensions:

i) Apple population (Type population): Females (19): L= 0.9 mm. (0.8-1.0 mm.); a= 49 (46-52); b= 4.1 (3.9-4.4); c= 67 (64-72); V^{12}_{9-14}= 50 (46-53).

Female (holotype): L= 0.9 mm.; a= 46; b= 4; c= 66; V^{12}= 48.

ii) Cotton population: Females (2): L= 0.84-0.96 mm.; a= 47-48; b= 3.9-4.2; c= 66-68; V^{11-12}= 51-52.

Description:

Female: Body curved in posterior-third of its length upon fixation, tapering gradually anterior to slender part of esophagus to a well set off lip region. Cuticle smooth, 1-2 μ thick. Lip region more than adjoining body-width wide and less than half of body-width at base of esophagus. Lips very distinctly angular; cephalic papillae easily visible. Four cuticularized platelets surrounding the stoma enterance present. Lateral chords about 1/8th-1/7th of body-width near vulva. Amphids cup-like, their apertures about half the head-width wide. Sensillar pouches not seen.

Spear 14-16 μ long, slightly less than twice the head-width, bent dorsally; its aperture occupying 1/6th-1/5th of spear length. Spear guiding ring double, near middle of spear, the anterior one more bright. Spear extensions simple, about one spear length long. Basal expanded portion of esophagus occupies less than half the total esophageal length. Width of the basal expanded portion about half of body-width at base of esophagus, and 1/8th-1/7th of its total length. Only dorsal esophageal gland nucleus and its opening visible. Nerve ring 80-85 μ from anterior end. Cardia somewhat conoid.

Vulva transverse, slit-like, about 1/5th of body-width. Vagina slightly less than half the body-width long. Anterior gonad absent, only a minute trace of anterior uterus present. Uterus and oviduct of the posterior sexual branch not distinctly separated, their combined length about four times the body-width. Ovary opisthodelphic and reflexed one-third

to half way back to vulva. Oocytes arranged in a single row. Prerectum 43-50 µ long, less than 4 times the anal body-width. Rectum 16-18 µ long, about one anal body-width. Tail convex-conoid to bluntly rounded, about one anal body-width long. A pair of obscure caudal pores present.

Male: Not found.

Habitat: Apple population (Type): Collected from soil around roots of apple, Pyrus malus from Srinagar, Kashmir.

Cotton population: From soil around roots of Gossypium hirsutum from Aligarh, U.P.

Type specimens: Collected in October, 1965; holotype with one paratype mounted on slide MSJ/Pungentus angulatus/1; the paratypes mounted on slides MSJ/Pungentus angulatus/2-4. Specimens from Aligarh mounted on slide MSJ/Pungentus angulatus/5.

Differential diagnosis: Pungentus angulatus n. sp., comes close to P. engadinensis (Altherr, 1950) Altherr, 1952 but differs in having angular lips (lips rounded in P. engadinensis); amphidial slits only half the head-width (amphidial slits 3/4th of head-width in P. engadinensis); slender body (a= 38-39 in P. engadinensis) and a short tail (c= 43 in P. engadinensis).

KEY TO SPECIES OF PUNGENTUS

1. Spear slender, about two head-widths long, slightly arcuate.....2

   Spear about one head-width long, straight.....11

2. Body length 3.5 mm. or over.....
.....textilis (Thorne and Swanger, 1936) Thorne, 1939
Body length 2.0 mm. or less.....3

3. Ovaries two.....4
Ovary single.....6

4. Lips angular, very prominent; length 2.0 mm.....
.....angulosus Thorne, 1939
Lips not angular, low or rounded; length 1.7 mm. or less.
.....5

5. Amphids about two-thirds as wide as head, narrowing rapidly with a slight constriction in the middle.....
.....pungens Thorne and Swanger, 1939
Amphids wine-glass shaped, only half the head-width.....
.....marietani Altherr, 1950

6. Anterior rudimentary uterine branch one or more than one body-width long; males known.....7
Anterior rudimentary uterine branch less than half body-width long; males unknown.....8

7. Anterior rudimentary uterine branch only one body-width long; tail hemispheroid.....
.....monohystera Thorne and Swanger, 1936
Anterior rudimentary uterine branch three body-widths long; tail usually conoid.....sparsus Thorne, 1939

8. Body length 1.0 mm. or less.....9
Body length 1.5 mm. or more.....10

9. Lips rounded; a= 38-39; c= 43.....
.....engadinensis (Altherr, 1950) Altherr, 1952
Lips angular; a= 46-52; c= 64-72 .....angulatus n. sp.

10. Lips very angular; amphid apertures three-fourths of head-width.....
....*silvestris* (de Man, 1912) Coomans and Geraert, 1962
Lips somewhat rounded; amphid apertures less than half head-width.....*maorium* Clark, 1963

11. Ovaries two.....12
Ovary one.....13

12. Body length 2.2 mm.....*brevidentatus* Thorne, 1939
Body length 0.6-0.7 mm.....*pumilus* Andrássy, 1963

13. Anterior uterine branch present.....14
Anterior uterine branch absent.....15

14. Body length 0.9 mm.; lips low, amalgamated.....
.....*microdentatus* Thorne, 1939
Body length 1.4 mm.; lips prominent, angular.....
.....*obscurus* Thorne, 1939

15. Body length 1.0 mm.:.....*parvus* Thorne, 1939
Body length 0.56 mm.....*mahunkai* Andrássy, 1968

Not included in the Key: The following species have been considered *species inquirendae* because of poor and inadequate descriptions.

Pungentus ichthyuris (Cobb, 1906) Thorne and Swanger, 1936

P. intertextus (Thorne and Swanger, 1936) Thorne, 1939

P. minnsi (van der Linde, 1938) Andrássy, 1960

P. stylidens (Schuurmans Stekhoven, 1951) Andrássy, 1960

P. fuorni (Altherr, 1950) Goodey, 1963.

GENUS DISCOLAIMUS Cobb, 1913

Discolaimus major Thorne, 1939

Habitats: i) Several females from Gossypium herbaceum from Allahabad, Bulandshahr and Muzaffarnagar. districts of U.P.

ii) Twenty females from Crotalaria juncea from Mirzapur district, U.P.

Discolaimus similis Thorne, 1939

Habitats: i) Several females from Gossypium herbaceum from Badaun, Bulandshahr, Mainpuri, Meerut and Saharanpur districts of U.P.

ii) Seventeen females from Crotalaria juncea from Banaras district, U.P.

Discolaimus brevis Siddiqi, 1964

Habitats: i) Twenty females from Gossypium hirsutum from Aligarh, U.P.

ii) Several females from Gossypium herbaceum from Allahabad, Kanpur, Mathura, Meerut, Muzaffarnagar and Saharanpur districts of U.P.

iii) Several females from Crotalaria juncea from Banaras, Jhansi and Kanpur districts of U.P.

Discolaimus tenax Siddiqi, 1964

Habitats: i) Six females from Gossypium hirsutum from Aligarh, U.P.

ii) Ten females from Gossypium herbaceum from Rampur district, U.P.

iii) Several females from Crotalaria juncea from Jhansi, Ghazipur and Mirzapur districts of U.P.

iv) Eight females from Hibiscus cannabinus from Jhansi district, U.P.

GENUS DISCOLAIMIUM Thorne, 1939

syn. Discolaimoides Heyns, 1963

The species of the genus Discolaimium are of common occurrence in Uttar Pradesh. The populations collected from around roots of fibrous crops are classified into 5 known and 4 new species of this genus.

Discolaimium bulbiferum (Cobb, 1906) Timm and Bhuiyan, 1963

This species is widely distributed in Uttar Pradesh. A brief description is given below because some variations have been observed in the specimens from different localities.

Dimensions:

Females (10): L= 1.46-1.66 mm.; a= 54-60; b= 4.4-5.0; c= 33-47; V= $\frac{6\text{-}8}{44\text{-}46}$ $\frac{6\text{-}8}{}$.

Description:

Female: Cuticle about 1 μ thick. Lateral chords about one-fifth to one-fourth body-width near middle. Glandular organs 100-115, irregularly arranged. Spear 10-13 μ long, about equal to head-width. Spear guiding ring 6-8 μ from anterior end. Spear extensions 18-21 μ in length. Basal expanded portion of esophagus occupies 51-54% of the total esophageal length (about 2/3rd according to Thorne, 1939). Prerectum 40-48 μ, about 2-3 times the anal body-width. Tail dorsally convex-conoid, terminus subacute, more than two anal body-widths long.

Habitats: i) Several females from Gossypium herbaceum from Agra, Allahabad, Badaun, Bulandshahr, Kanpur, Mainpuri, Mathura, Meerut, Muzaffarnagar, Rampur and Saharanpur districts of U.P.

ii) Eight females from Gossypium arboreum from district Moradabad, U.P.

iii) Several females from Crotalaria juncea from Banaras, Jalaun, Jhansi, Ghazipur, Kanpur, Mirzapur and Shahjahanpur districts of U.P. Three females were also collected from Ajanta, Maharashtra.

Discolaimium monhystera Siddiqi, 1965

Habitat: Seven females from Crotalaria juncea from Chunar, district Mirzapur, U.P.

Discolaimium simplex Siddiqi, 1965

Habitat: Fifteen females from Crotalaria juncea from Mirzapur, U.P.

Discolaimium brachyurum Husain and Siddiqi, 1967

Habitat: Twenty three females from Hibiscus cannabinus from Kanpur and Mirzapur districts, U.P.

Discolaimium arcuatum Husain and Siddiqi, 1967

Habitat: Twelve females from Crotalaria juncea from Banaras and Jhansi districts, U.P.

Discolaimium mazhari* n. sp.

(Plate: XVI, Figs. A-E)

Dimensions:

Females (4): L= 1.11-1.27 mm.; a= 30-41; b= 3.8-4.3; c= 60-64; $V = \frac{5-7}{42-44}\frac{6-7}{}$.

Female (holotype): L= 1.21 mm.; a= 30; b= 3.9; c= 61; $V = \frac{6}{45}\frac{7}{}$.

Description:

Female: Body cylindroid, tapering gradually anterior to slender part of esophagus and slightly curved in the posterior half of its length upon fixation. Cuticle smooth,

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*Named after Mohd. Mazhar Ahsan Naqvi, who collected the soil sample containing these worms.

its thickness varies between 1-3 μ at various places in the body (3 μ thick on tail). Subcuticle with faint striations, less than 1 μ thick. Head well set off, wider than the adjoining body, its diameter 2/5th-2/3rd of the body-width at base of esophagus. Lips distinctly modifying the head contour. Lateral chords 1/6th-1/4th the body-width near middle. Lateral glandular organs conspicuous, 75-82 in number, irregular in size and arrangement. Amphids cup-like, their apertures 4-5 μ from anterior end occupy 5-6 μ or about one half of the corresponding body-width. Sensillar pouches not visible.

Spear 11-12 μ long, aperture more than half of its length. Guiding ring 5-6 μ from anterior end. Spear extensions 21-22 μ, simple. Basal expanded portion of esophagus occupies 55-56% of total esophageal length, its width slightly more than one-half of body-width at base of esophagus and 1/10th-1/8th of its own length. Opening of dorsal esophageal gland 153-157 μ or 48-52% of the esophageal length from the anterior end. The first pair of subventral esophageal glands open 56-72 μ from the dorsal esophageal gland opening and the second pair opens 29-37 μ below the opening of the first pair. Nerve ring 85-94 μ from anterior end. Cardia spatulate, with two lobes at the sides.

Vulva transverse. Vagina 10-13 μ, extending 1/4th-1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 62-80 μ and 68-81 μ of the anterior and

posterior gonads respectively. No sperms in uteri. Ovaries with single flexure; oocytes arranged in a single row except at the tip. Prerectum 15-19 μ, less than one anal body-width. Rectum 18-20 μ, about one anal body-width long. Tail hemispheroid, swollen, about one anal body-width long. Two minute caudal pores present.

Male: Not found.

Habitat: Soil around roots of Gossypium arboreum from Disond Hakimpur, district Bijnor, U.P.

Type specimens: Collected in November, 1966; holotype mounted on slide MSJ/Discolaimium mazhari/1; 4 paratypes on slide MSJ/Discolaimium mazhari/2.

Differential diagnosis: Discolaimium mazhari n. sp., comes close to D. cylindricum Thorne, 1939, D. pseudoporum Fielding, 1950 and D. brachyurum Husain and Siddiqi, 1967. From D. cylindricum it differs in having spear aperture more than half of spear length, glandular organs 75-82 (40-60 in D. cylindricum) and a swollen tail. From D. pseudoporum it differs in having shorter body length, glandular organs 75-82 (45-55 in D. pseudoporum) spear aperture more than half of spear length, shorter prerectum, absence of axial terminal pore-like structure and longer tail. From D. brachyurum it can be differentiated in having two lobes at the sides of cardia and swollen tail.

Discolaimium upum n. sp.

(Plate: XVI, Fig. F-I)

Dimensions:

Females (10): L= 0.84 mm. (0.78-0.89 mm.); a= 38 (36-42); b= 4.0 (3.5-4.5); c= 44 (41-47); $V = \begin{matrix} 7 & 8 \\ 47 & \\ 6\text{-}9 & 6\text{-}10 \end{matrix}$ (45-48).

Female (holotype): L= 0.86 mm.; a= 39; b= 4.4; c= 47; $V = \begin{matrix} 7 & 8 \\ 44 & \end{matrix}$.

Description:

Female: Body cylindroid, tapering gradually anterior to slender part of esophagus and curved from behind the base of esophagus. Cuticle smooth, about 1 μ thick. Subcuticle with faint striations, less than 1 μ thick. Head set off from the body by a constriction, its width less than one-half of body-width at base of esophagus. Lips conoid, modifying the head contour. Lateral chords distinct, 1/6th-1/5th the body-width near middle. Lateral glandular organs conspicuous, 35-40 in number, irregular in size and arrangement. Amphids cup-like, their apertures 4 μ from anterior end, occupy 5-6 μ or more than half the corresponding body-width. Sensillar pouches 20-22 μ from amphidial slits.

Spear 10-12 μ long, aperture less than half of its length. Guiding ring 5-6 μ from anterior end. Spear extensions 14-16 μ, simple. Basal expanded portion of esophagus occupies 45-50% of total esophageal length, its width more than half of body-width at base of esophagus and

1/9th-1/7th of its own length. Opening of dorsal esophageal gland 111-130 μ or 56-60% of the esophageal length from the anterior end. The first and second pair of subventral esophageal glands and their openings not visible. Nerve ring 73-84 μ from anterior end. Cardia hemispheroid.

Vulva a transverse slit. Vagina 8-10 μ, about 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 54-61 μ and 57-82 μ of the anterior and posterior sexual branches respectively. No sperms in uteri. Ovaries with single flexure; oocytes arranged in a single row except at the tip. Prerectum 43-54 μ, three to four anal body-widths long. Rectum 11-16 μ, about one anal body-width long. Tail rounded, about one and a half anal body-widths long. Two minute caudal pores present.

Male: Not found.

Habitat: Soil around roots of Gossypium herbaceum from Sanna, district Etah, U.P.

Additional locality: Four females from Gossypium hirsutum from Aligarh, U.P.

Type specimens: Collected in November, 1966; holotype along with 7 paratypes mounted on slide MSJ/Discolaimium upum/1; three paratypes on slide MSJ/Discolaimium upum/2.

Differential diagnosis: Discolaimium upum n. sp., comes close to D. sublatum Heyns, 1963 and D. latum Thorne,

1939. From the former it differs in having slightly shorter spear; more glandular organs (25 in D. sublatum), amphids more than half as wide as head (half as wide in D. sublatum) and prerectum three to four anal body-widths long (only one anal body-width long in D. sublatum). From D. latum it differs in having spear longer than head-width and guiding ring posterior to head constriction (spear less than head-width and guiding ring anterior to head constriction in D. latum), slender body (a= 24 in D. latum), slightly longer tail (about one anal body-width long in D. latum) and anterior position of vulva (V= 54 in D. latum).

Discolaimium mukhtarpuriensis n. sp.

(Plate: XVII)

Dimensions:

i) Mukhtarpur population (Type population): Females (5): L= 0.80-1.16 mm.; a= 32-35; b= 4.1-4.8; c= 35-41; V= $\frac{7-12}{52-57}$ $\frac{9-11}{}$.

Female (holotype): L= 1.18 mm.; a= 33; b= 5.0; c= 38; V= $\frac{11}{53}$ $\frac{14}{}$.

ii) Ghazipur population: Females (2): L= 1.10-1.14 mm.; a= 37-39; b= 4.8; c= 31-37; V= $\frac{9-12}{52-53}$ $\frac{8-9}{}$.

Description:

Female: Body slightly curved in posterior third of its length when relaxed and tapering gradually anterior to slender part of esophagus. Cuticle smooth, its thickness

varies between 1-3 μ at various places in the body (3 μ thick on tail). Subcuticle with faint striations, less than 1 μ thick. Head well set off, its width less than half of body-width at base of esophagus. Lips somewhat conoid, modifying the head contour and bearing the usual number of cephalic papillae. Lateral chords 1/5th-1/4th of body-width near middle. Amphids cup-like, their apertures 4-5 μ from anterior end and occupying 5-6 μ or more than one half of corresponding body-width. Sensillar pouches not seen.

Spear 16-18 μ long, cylindrical; aperture 5-6 μ. Guiding ring 9-10 μ from anterior end. Spear extensions simple, 15-17 μ. Basal expanded portion of esophagus occupies 33-36% of the total esophageal length, its width about one half of body-width at base of esophagus and 1/6th-1/5th of its own length. Opening of the dorsal esophageal gland 134-152 μ or 57-63% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 21-26 μ from the dorsal esophageal gland opening and the second pair opens 27-30 μ below the opening of the first pair. Nerve ring 99-114 μ from anterior end. Cardia rounded, esophago-intestinal disc present.

Vulva a transverse slit. Vagina 9-10 μ, extending about 1/4th-1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 80-125 μ and 104-126 μ of the anterior and posterior sexual branches respectively. No sperms in the uteri. Ovaries reflexed; oocytes arranged in a single row except at tip. Size of eggs 85-89 x 24-32 μ.

Prerectum 72-102 μ, about 3.5-5.5 times the anal body-width. Rectum 18-22 μ, about equal to anal body-width. Tail dorsally convex-conoid with a rounded terminus, about one and a half anal body-widths long. Two minute caudal pores present.

Male: Not found.

Habitat: Mukhtarpur population (Type): Soil around roots of Gossypium herbaceum from Mukhtarpur, district Bijnor, U.P.

Ghazipur population: Soil around roots of Gossypium hirsutum from Ghazipur, U.P.

Additional locality: Four females from Gossypium arboreum from Rampur, U.P.

Type specimens: Collected in November, 1966; holotype along with 2 paratypes mounted on slide MSJ/Discolaimium mukhtarpuriensis/1; 3 paratypes on slide MSJ/Discolaimium mukhtarpuriensis/2. Specimens from Ghazipur on slide MSJ/ Discolaimium mukhtarpuriensis/3.

Differential diagnosis: Discolaimium mukhtarpuriensis n. sp., comes close to D. simplex Siddiqi, 1965 and D. conura Thorne, 1939. From D. simplex it differs in having a smaller and stouter body (L= 1.25-1.56; a= 40-48 in D. simplex), deep amphidial pouches, smaller spear extensions (one and a half times of spear in D. simplex), smaller enlarged portion of esophagus (enlarged portion of esophagus 2/3rd of esophageal length in D. simplex) and post-equatorial vulva. From

D. conura it differs in having differently shaped amphids, spear about one and a half times the head-width (less than one head-width long in D. conura), shorter spear aperture (about one half the spear length in D. conura) and longer prerectum (about one anal body-width long in D. conura).

Discolaimium longicaudatum n. sp.

(Plate: XVIII)

Dimensions:

Females (3): L= 1.14-1.27 mm.; a= 48-53; b= 4.4-4.7; c= 25-32; $V = \frac{6-7}{44-49}\frac{}{}\frac{6-8}{}$.

Female (holotype): L= 1.24 mm.; a= 56; b= 4.4; c= 26; $V = \frac{8}{48}\frac{7}{}$.

Description:

Female: Body curved in posterior half of its length and tapering gradually anterior to slender part of esophagus. Cuticle finely striated, its thickness varies between 1-3 μ at various places in the body (2-3 μ thick on tail). Subcuticle with faint striations, less than 1 μ thick. Head well set off by a deep constriction, wider than adjoining body, about 1/3rd of body-width at base of esophagus. Lips distinctly modifying head contour. Lateral chords 1/6th-1/4th body-width near middle. Lateral glandular organs conspicuous, 51-58 in number, irregular in size and arrangement. Amphids cup-like, their apertures 3-4 μ from anterior end, occupy 4-5 μ or about 3/4th corresponding body-width.

Sensillar pouches 18-19 μ from amphidial slits.

Spear 9-10 μ long, its aperture 4-5 μ. Guiding ring 4-5 μ from anterior end. Spear extensions 15-16 μ long, simple. Basal expanded portion of esophagus occupies 51-55% of total esophageal length, its width about 1/2 of body width at base of esophagus and 1/13th-1/12th of its own length. Opening of dorsal esophageal gland 144-155 μ or 52-57% of esophageal length from anterior end. The first pair of subventral esophageal glands open 26-30 μ from the dorsal esophageal gland opening and the second pair opens 40-52 μ below the opening of the first pair. Nerve ring 93-98 μ from anterior end. Cardia hemispheroid, esophago-intestinal disc present.

Vulva a transverse slit. Vagina 9-10 μ, extending less than 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 85-107 μ and 80-101 μ of the anterior and posterior gonads respectively. No sperms in uteri. Ovaries with single flexure; oocytes arranged in a single row except at tip. Prerectum 37-59 μ, 3-5 anal body-widths long. Rectum 12-15 μ, about one anal body-width long. Tail elongate-conoid with rounded tip, ventrally arcuate, about 3-4 anal body-widths long.

Male: Not found.

Habitat: Soil around roots of Gossypium herbaceum from Bamanheri, district Muzaffarnagar, U.P.

Type specimens: Collected in October, 1966; holotype along with 3 paratypes mounted on slide MSJ/Discolaimium longicaudatum/1.

Differential diagnosis: Discolaimium longicaudatum n. sp., comes close to Discolaimium arcuicaudatum Furstenberg and Heyns, 1965 and Discolaimium arcuatum Husain and Siddiqi, 1967. From the former it differs in having shorter body length (1.45-1.53 mm. in D. arcuicaudatum); narrower lateral chords (1/3rd in D. arcuicaudatum), more glandular organs (30-40 in D. arcuicaudatum) and shorter tail (4-5 anal body-widths long in D. arcuicaudatum). From D. arcuatum it differs in having longer spear (7-8 μ in D. arcuatum); posteriorly situated guiding ring (anterior to labial constriction in D. arcuatum); absence of non-muscular sheath covering the basal expanded portion of esophagus and longer prerectum (one anal body-width long in D. arcuatum).

KEY TO SPECIES OF DISCOLAIMIUM

1. Ovary single.....2
   Ovaries two.....4
2. Body length more than 1.75 mm.; tail rounded.....
   .....sabuli Yeates, 1967
   Body length less than 1.25 mm.; tail convex-conoid.....3
3. Lateral glandular organs conspicuous; tail about one anal body-width long.....
   .....smithi (Heyns, 1963) Timm and Bhuiyan, 1963
   Lateral glandular organs inconspicuous; tail about two anal body-widths long.....monhystera Siddiqi, 1965

4. Tail rounded.....5
   Tail conoid.....11
5. Body length 1.7 mm.; c= 80-100.....
   .....pseudoporum Fielding, 1950
   Body length 1.3 mm. or less; c= 59 or less.....6
6. Spear aperture about 2/3rd of spear length.....7
   Spear aperture half or less of spear length.....8
7. Tail end swollen.....mazhari n. sp.
   Tail end not swollen.....
   .....brachyurum Husain and Siddiqi, 1967
8. Body length 1.3 mm.; c= 59.....cylindricum Thorne, 1939
   Body length 0.9 mm. or less; c= 51 or less.....9
9. Spear length less than one head-width; guiding ring anterior to head constriction.....latum Thorne, 1939
   Spear length one head-width; guiding ring posterior to head constriction.....10
10. Spear length 14 μ; glandular organs 25; prerectum one anal body-width long.....sublatum Heyns, 1963
    Spear length 11-12 μ; glandular organs 35-40; prerectum 3-4 anal body-widths long.....upum n. sp.
11. Ellipsoidal swelling at junction of spear extensions and esophageal lumen double.....
    .....tenue Furstenberg and Heyns, 1965
    Ellipsoidal swelling at junction of spear extensions and esophageal lumen single.....12
12. Lateral glandular organs conspicuous.....13
    Lateral glandular organs inconspicuous or absent.....19

13. Tail ventrally arcuate.....14
Tail not ventrally arcuate.....17

14. Tail about 2 anal body-widths long.....
.....*gracile* Thorne, 1939
Tail 3-5 anal body-widths long.....15

15. Body length 1.45-1.53 mm.; lateral glandular organs 30-40.....*arcuicaudatum* Furstenberg and Heyns, 1965
Body length 0.90-1.27 mm.; lateral glandular organs more than 50.....16

16. Spear guiding ring anterior to head constriction; basal expanded portion of esophagus enveloped by a faint non-muscular sheath.....*arcuatum* Husain and Siddiqi, 1967
Spear guiding ring posterior to head constriction; basal expanded portion of esophagus not enveloped by a non-muscular sheath.....*longicaudatum* n. sp.

17. Body length 2.2 mm.....*gigas* Fielding, 1950
Body length less than 1.8 mm.....18

18. Lateral glandular organs 100-115; spear 10-13 μ long...
.....*bulbiferum* (Cobb, 1906) Timm and Bhuiyan, 1963
Lateral glandular organs 67; spear 19-20 μ long.....
.....*simplex* Siddiqi, 1965

19. Spear aperture more than 1/2 of spear length; c= 48-54.
.....*paraconura* Siddiqi, 1965
Spear aperture about 1/2 of spear length or less; c= 31-41.....20

20. Spear less than one head-width long, its aperture about 1/2 of spear length.....conura Thorne, 1939

Spear more than one head-width long, its aperture about 1/3rd of spear length.....mukhtarpuriensis n. sp.

Not included in the key:

Discolaimium obtusum Husain and Siddiqi, 1967 which has been transferred to the genus Durinema Jairajpuri, 1968 of the superfamily Belondiroidea (vide Jairajpuri, 1968).

FAMILY APORCELAIMIDAE Heyns, 1965

Heyns (1965) proposed the family Aporcelaimidae to accommodate those genera which have generally large body; thick cuticle, occasionally marked with criss-cross lines, and usually provided with lateral, ventral and dorsal body pores; lip region set off; oral aperture mostly with a dorso-ventral slit, rarely hexagonal; pharynx provided with an axial spear having a large aperture, or a ventrally situated dorylaimoid spear, narrower than the lumen of the pharynx, or with a mural tooth. The following genera were included under this family: Sectonema Thorne, 1930; Aporcelaimus Thorne and Swanger, 1936; Aporcelaimellus Heyns, 1965; Makatinus Heyns, 1965; Aporcelaimoides Heyns, 1965 and Scapidens Heyns, 1965. During the present investigations several specimens of Aporcelaimus, Aporcelaimellus and Sectonema were obtained. They represent the following new species:

1. Aporcelaimellus heynsi
2. A. indicus
3. A. hemicaudatus
4. A. raisi
5. Sectonema procta

GENUS APORCELAIMELLUS Heyns, 1965

Aporcelaimellus heynsi n. sp.

(Plate: XIX, Figs. A-G)

Dimensions:

i) Ajitgunj population (Type population): Females (3): L= 1.09-1.16 mm.; a= 32-34; b= 3.5-4.0; c= 32-34; $V = \overset{6-10}{53-55}$.

Female (holotype): L= 1.12 mm.; a= 31; b= 4.0; c= 31; $V = \overset{6}{55}$.

ii) Mukhtarpur population: Females (3): L= 1.10-1.20 mm.; a= 32-34; b= 3.7-4.0; c= 31-34; $V = \overset{7-9}{51-54}$.

iii) Iglas population: Females (11): L= 1.10 mm. (0.98-1.22 mm.); a= 32 (29-34); b= 4.1 (3.4-4.3); c= 34 (28-39); $V = \overset{7}{53}$ ($\overset{6-11}{51-56}$).

Description:

Female: Body cylindroid, tapering gradually anterior to slender part of esophagus and curved in posterior third of its length upon fixation. Cuticle marked with faint striations, 1-4 μ thick at various places in the body (4 μ thick on tail). Subcuticle distinctly striated, less than 1 μ thick. Lip region well set off from body, its width about 1/3rd of the body-width at base of esophagus (a female from Mukhtarpur population has less wider and slightly differently shaped lip region, Fig. C). Lips conoid, modifying the head contour. Labial papillae distinct. Lateral chords granular, 1/5th-1/4th of body-

width near middle. Lateral, dorsal and ventral body pores not visible. Amphids cup-like, their apertures 4 μ from anterior end, occupy 6-7 μ or more than half the corresponding body-width. Sensillar pouches 16-18 μ from amphidial slits.

Spear 11-13 u long, its aperture 7-9 μ. Guiding ring 5-6 μ from anterior end. Spear extensions 17-19 μ, simple. Basal expanded portion of esophagus occupies 45-50% of total esophageal length, its width about 1/2 the body-width at base of esophagus and 1/9th-1/6th of its own length. Opening of dorsal esophageal gland 145-190 μ or 55-59% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 43-48 μ from the dorsal esophageal gland opening and the second pair opens 23-26 μ below the opening of the first pair. Nerve ring 86-95 μ from anterior end. Esophago-intestinal disc present. Cardia hemispheroid.

Vulva pore-like. Vagina 10-14 μ, about 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 72-133 μ and 82-115 μ of the anterior and posterior gonads respectively. No sperms in uteri. Ovaries with single flexure; oocytes arranged in a single row except at the tip. Egg 90-92 x 33-34 μ. Prerectum 52-75 μ, 2½-4 anal body-widths long. Rectum 21-24 μ, about one anal body-width long. Tail conoid with rounded terminus, 29-41 μ or 1½-2 anal body-widths long. Two minute caudal pores present.

Male: Not found.

Habitat: Ajitgunj population (Type): Soil around roots of Gossypium herbaceum from Ajitgunj, district Mainpuri, U.P.

Mukhtarpur and Iglas populations: From soil around roots of Gossypium arboreum from Mukhtarpur, district Bijnor, and Iglas, district Aligarh, U.P.

Additional localities: Few specimens were also collected from Bulandshahr and Meerut districts of U.P.

Type specimens: Collected in October, 1966; holotype along with paratypes mounted on slide MSJ/Aporcelaimellus heynsi/1. Mukhtarpur and Iglas populations mounted on slides MSJ/Aporcelaimellus heynsi/2-5.

Differential diagnosis: Aporcelaimellus heynsi n. sp., comes close to A. paraconicaudatus (Meyl, 1956) Heyns, 1965 and A. maitai Yeates, 1967. From the former it differs in having shorter spear (spear 16 μ in A. paraconicaudatus as calculated from Meyl's figures); slender body (a= 21-22 in A. paraconicaudatus); esophago-intestinal disc and differently shaped tail. From A. maitai it differs in having no glandular organs in hypodermal chords; longer spear extensions (half of spear length in A. maitai) and presence of esophago-intestinal disc.

Aporcelaimellus indicus n. sp.

(Plate: XIX, Figs. H-K)

Dimensions:

Females (3): L= 2.40-2.45 mm.; a= 49-50; b= 4.7-4.9; c= 41-43; V= $\frac{13\text{-}16}{57\text{-}58}$ $\frac{12\text{-}13}{}$

Female (holotype): L= 2.42 mm.; a= 49; b= 4.7; c= 42; V= $\frac{15}{58}$ $\frac{13}{}$.

Description:

Female: Body stout, cylindroid, tapering gradually anterior to slender part of esophagus and curved posterior to vulva upon fixation. Cuticle smooth, its thickness varies between 2-6 μ at various places in the body. Subcuticle marked with fine striations, less than 1 μ thick. Lip region marked off from the body by a depression, wider than the adjoining body and about 1/3rd as wide as body-width at base of esophagus. Lips low and somewhat angular. Labial papillae visible. Lateral chords less than 1/4th of body-width near middle. Lateral, dorsal and ventral body pores not seen. Amphids broad and shallow, their apertures 4 μ from anterior end, occupy 9-10 μ or about 3/5th the corresponding body-width. Sensillar pouches not seen.

Spear 16 μ long, its aperture 9-10 μ. Guiding ring thick, 7 μ from anterior end. Spear extensions 34-35 μ, simple. Anterior slender part of esophagus 12-14 μ wide,

not well demarcated from the posterior expanded portion, narrowing slightly as it passes through the nerve ring. Basal expanded portion of esophagus occupies 56-57% of total esophageal length, its width less than half of body-width at base of esophagus and about 1/16th of its own length. Opening of dorsal esophageal gland 300-310 μ or 56-58% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 90-98 μ from the dorsal esophageal gland opening and the second pair opens 145-150 μ below the opening of the first pair. Nerve ring 148-150 μ from anterior end. A cushion-shaped esophago-intestinal disc present. Cardia hemispheroid.

Vulva pore-like. Vagina 28 μ, extending 3/5th across the body. Gonads amphidelphic. Oviduct and uterus distinctly separated by a sphincter in both the sexual branches. Combined length of oviduct and uterus 367-380 μ and 306-320 μ of the anterior and posterior gonads respectively. No sperms in uteri. Ovaries with single flexure; oocytes arranged in a single row except at the tip. Prerectum 125-128 μ or about 4 times the anal body-width. Rectum 40-42 μ, more than one anal body-width long. Tail 56-60 μ, slightly less than twice the anal body-width, conoid, ventrally arcuate with rounded tip. Two minute caudal pores present.

Male: Not found.

Habitat: Soil around roots of Gossypium hirsutum from Ajitgunj, district Mainpuri, U.P.

Type specimens: Collected in November, 1966; holotype mounted on slide MSJ/Aporcelaimellus indicus/1; paratypes on slides MSJ/Aporcelaimellus indicus/2-3.

Differential diagnosis: Aporcelaimellus indicus n. sp., comes close to A. williamsi Heyns, 1965 and A. mamillatus (Williams, 1959) Heyns, 1965. From the former it differs in having low lips, shorter spear (spear 20 µ in A. williamsi); longer and differently shaped tail (tail less than one anal body-width long and bluntly conoid in A. williamsi). From A. mamillatus it differs in having slender body (a= 20-30 in A. mamillatus); shorter spear (20-27 µ long in A. mamillatus); spear aperture comparatively larger (about half the spear length in A. mamillatus) and differently shaped tail (tail with a teat-like terminus in A. mamillatus). Males are known for both A. williamsi and A. mamillatus while they were not found in A. indicus and sperms were also not seen in its uteri.

Aporcelaimellus hemicaudatus n. sp.

(Plate: XX, Figs. A-D)

Dimensions:

i) Malpura population (Type population): Females (5): L= 2.00-2.51 mm.; a= 25-34; b= 3.7-4.8; c= 58-68; V= $\frac{7\text{-}10}{50\text{-}53}$.

Female (holotype): L= 2.53 mm.; a= 34; b= 4.5; c= 68; V= $\frac{10}{53}\frac{8}{}$.

ii) Ghazipur population: Females (2): L= 1.98-2.23 mm.; a= 28-31; b= 3.7-4.0; c= 65-73; V= $\frac{7-8}{51-52}\frac{8-9}{}$

Description:

Female: Body cylindroid, stout, tapering gradually anterior to slender part of esophagus and slightly curved in posterior half of its length upon fixation. Cuticle marked with faint striations, 3-9 μ thick at various places in the body (7-9 μ thick on tail). Subcuticle distinctly striated, less than 1 μ thick. Lip region well set off from body, its width about 1/5th-1/4th of the body-width at base of esophagus. Lips rounded, modifying the head contour. Labial papillae distinct. Lateral chords granular, 1/8th-1/6th of body-width near middle. Lateral, dorsal and ventral body pores not visible. Amphids cup-like, their apertures about 6 μ from anterior end and occupy 9 μ or less than half the corresponding body-width. Sensillar pouches not seen.

Spear 21-23 μ long, more than one head-width long, its aperture 11-13 μ. Spear guiding ring about 10 μ from anterior end. Spear extensions 30-33 μ long, about one and a half of spear length. Basal expanded portion of esophagus occupies 52-55% of total esophageal length, its width less than one half the body width at base of esophagus and 1/10th-1/8th of its own length. Opening of dorsal esophageal gland 249-268 μ or 48-51% of the esophageal length from anterior

end. The first pair of subventral esophageal glands open 50-68 μ from dorsal esophageal gland opening and the second pair opens 80-90 μ below the opening of the first pair. Nerve ring 160-187 μ from anterior end. Esophago-intestinal disc present. Cardia with conoid tip.

Vulva pore-like. Vagina 27-31 μ, extending about 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 148-240 μ and 145-180 μ of the anterior and posterior gonads respectively. No sperms in uteri. Ovaries with single flexure. Oocytes arranged in a single row except at the tip. Egg 100 x 56 μ. Prerectum 92-127 μ, 2-3 anal body-widths long. Rectum 41-46 μ, about one anal body-width long. Tail bluntly rounded, less than one anal body-width long. Caudal pores not observed.

Male: Not found.

Habitat: Malpura population (Type): Soil around roots of Gossypium herbaceum from Malpura, district Agra, U.P.

Ghazipur population: Soil around roots of Crotalaria juncea from Ghazipur, U.P.

Type specimens: Collected in November, 1966; holotype mounted on slide MSJ/Aporcelaimellus hemicaudatus/1; paratypes on slides MSJ/Aporcelaimellus hemicaudatus/2-4. Specimens from Ghazipur on slide MSJ/Aporcelaimellus hemicaudatus/5.

Differential diagnosis: Aporcelaimellus hemicaudatus n. sp., comes close to A. vanderlaani (Meyl, 1957) Heyns, 1965 and A. williamsi Heyns, 1965. From the former it differs in the absence of lateral body pores; in having rounded lips; differently shaped amphids; longer spear (spear about one head-width long in A. vanderlaani) and shorter spear extensions (spear extensions about twice the spear length in A. vanderlaani). From A. williamsi it differs in having rounded lips; deep amphidial pouches; longer spear (spear about one head-width long in A. williamsi) and differently shaped tail. From both A. vanderlaani and A. williamsi it can further be differentiated in having distinct esophago-intestinal disc.

Aporcelaimellus raisi* n. sp.

(Plate: XX, Figs. E-H)

Dimensions:

Female (holotype): L= 2.60 mm.; a= 28; b= 4.6; c= 70; $V = \frac{9}{49}\frac{8}{}$.

Description:

Female: Body cylindroid, stout, tapering gradually anterior to slender part of esophagus and curved in the posterior half of its length upon fixation. Cuticle marked with faint striations, 5-9 μ thick at various places in the body (9 μ thick on tail). Subcuticle distinctly striated,

*Named after Rais H. Zaidi, who collected the sample containing this worm.

less than 1 μ thick. Lip region well set off from body, its width about 1/4.5 of the body-width at base of esophagus. Lips rounded, modifying the head contour and bearing the usual number of papillae. Lateral chords granular, about 1/6th the body-width near middle. Lateral, dorsal and ventral body pores not visible. Amphids very broad and deep, cup-like; their apertures about 4 μ from the anterior end and occupy about 14 μ or about 90% of the corresponding body-width. Sensillar pouches not seen.

Spear 19 μ, about 3/4th the head-width long; its aperture 12 μ. Spear guiding ring 9 μ from anterior end. Spear extensions 37 μ long, about twice the spear length. Basal expanded portion of esophagus occupies 55% of total esophageal length, its width about 1/2 the body-width at base of esophagus and about 1/10th of its own length. Opening of the dorsal esophageal gland 300 u or 51% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 100 μ from dorsal esophageal gland opening and the second pair opens 56 μ below the opening of the first pair. Nerve ring 222 μ from anterior end. Esophago-intestinal disc present. Cardia long, spatulate.

Vulva pore-like. Vagina 30 μ, about 1/3rd the corresponding body-width. Gonads amphidelphic. Oviduct and uterus distinctly separated by sphincter in both the sexual branches. Combined length of oviduct and uterus 244 and 222 μ of the anterior and posterior gonads respectively. No sperms in

uteri. Ovaries with a single flexure. Oocytes arranged in a single row except at tip. Prerectum 148 μ, less than four times the anal body-width. Rectum 48 μ, more than one anal body-width long. Tail bluntly rounded, less than one anal body-width long. Two minute caudal pores present.

Male: Not found.

Habitat: Soil around roots of Gossypium herbaceum from Ajitganj, district Mainpuri, U.P.

Type specimen: Collected in November, 1966; holotype mounted on slide MSJ/Aporcelaimellus raisi/1.

Differential diagnosis: Aporcelaimellus raisi n. sp., comes close to A. vanderlaani (Meyl, 1957) Heyns, 1965 and A. hemicaudatus. From the former it differs in the absence of lateral body pores; in having rounded lips; wider amphidial slits; shorter spear (spear one head-width in A. vanderlaani) and distinct esophago-intestinal disc. From A. hemicaudatus it differs in having wider amphidial slits; shorter spear (more than one head-width long in A. hemicaudatus); longer spear extensions (spear extensions one and a half spear length in A. hemicaudatus); differently shaped cardia and presence of sphincter in sexual branches.

Discussion: These four new species of Aporcelaimellus described above possess esophago-intestinal disc, although Heyns (1965) mentions that this structure is absent in

Aporcelaimellus. However, in other characters these species fit perfectly well under Aporcelaimellus.

KEY TO SPECIES OF APORCELAIMELLUS

1. Amphids duplex.....2
   Amphids simple.....3
2. Body length 3 mm.....
   .....obscurus (Thorne and Swanger, 1936) Heyns, 1965
   Body length 2 mm.....
   .....amylovorus (Thorne and Swanger, 1936) Heyns, 1965
3. Tail terminates with a teat-like terminus.....
   .....mamillatus (Williams, 1959) Heyns, 1965
   Tail terminates without a teat-like terminus.....4
4. Tail conoid or bluntly conoid.....5
   Tail bluntly rounded.....15
5. Amphidial pouches shallow.....6
   Amphidial pouches deep.....7
6. Spear 20 μ; tail less than one anal body-width long...
   .....williamsi Heyns, 1965
   Spear 16 μ; tail about 2 anal body-widths long.....
   .....indicus n. sp.
7. Body length less than 1.4 mm.; c= less than 40.....8
   Body length more than 1.5 mm.; c= more than 46.....10
8. Glandular organs present in hypodermal chords; spear extensions half of spear length....maitai Yeates, 1967
   Glandular organs absent in hypodermal chords; spear extensions more than one spear length.....9

9. Spear 16 μ; a= 21-22.....
.....paraconicaudatus (Meyl, 1956) Heyns, 1965
Spear 11-13 μ; a= 29-34.....heynsi n. sp.

10. Spear extensions less than half of spear length.....
.....taylori Yeates, 1967
Spear extensions more than one and a half of spear length.....11

11. Tail about one and a half anal body-widths long....12
Tail one anal body-width long or less.....13

12. Spear one and one-third times the head-width.....
.....capitatus (Thorne and Swanger, 1936) Heyns, 1965
Spear one head-width long.....
.....seinhorsti (Meyl, 1957) Heyns, 1965

13. Spear one and a half head-width long.....
.....nivalis (Altherr, 1952) Heyns, 1965
Spear one head-width long.....14

14. Lip region narrower than adjoining body; tail less than half anal body-width long.....
.....krygeri (Ditlevsen, 1928) Heyns, 1965
Lip region wider than adjoining body; tail about one anal body-width long.....
.....gerlachi (Meyl, 1956) Heyns, 1965

15. Lips angular; esophago-intestinal disc absent.....
.....vanderlaani (Meyl, 1957) Heyns, 1965
Lips rounded; distinct esophago-intestinal disc present.....16

16. Amphidial apertures occupy less than 50% the corresponding body-width; spear extensions one and a half the spear length.,.....hemicaudatus n. sp.
Amphidial apertures occupy about 90% the corresponding body-width; spear extensions twice the spear length.....raisi n. sp.

GENUS SECTONEMA Thorne, 1930

Thorne (1930) compared the genus Sectonema with Dorylaimus regius (now Aporcelaimus regius); in 1939, he placed it under the subfamily Nygolaiminae of the family Dorylaimidae. Meyl (1960) raised Nygolaiminae to a familial rank. Heyns (1965) shifted Sectonema to Aporcelaimidae because of its resemblance to the genus Aporcelaimus Thorne and Swanger, 1936 in the following characters: Large body; thick cuticle, usually with criss-cross lines, with numerous lateral, ventral and dorsal cuticular pores; head with distinct lips, set off by a deep constriction; oral aperture a dorsoventral slit; a flattened disc between the base of esophagus and the cardia; vulva generally with cuticularized lips; tail usually short and bluntly rounded; eggs small; predacious on oligochaetes. According to Heyns (1965) the tooth of Sectonema which apparently resembles the mural tooth of Nygolaimus Cobb, 1913, has evolved from Aporcelaimus type of spear. The dorsally grooved tooth of Sectonema represents the anterior ventral part of Aporcelaimus in which

the part posterior to spear aperture (or the dorsal arm of spear) has completely disappeared because of progressive increase in the size of spear aperture.

Sectonema procta n. sp.

(Plate: XXI)

Dimensions:

Females (3): L= 4.9-5.5 mm.; a= 56-57; b= 5.0-5.4; c= 116-134; V= $\frac{10\text{-}11}{53\text{-}57}$ $\frac{9\text{-}10}{\ }$.

Female (holotype): L= 5.5 mm.; a= 57; b= 5.4; c= 123; V= $\frac{10}{53}$ $\frac{9}{\ }$.

Description:

Female: Body long cylindroid, curved in posterior third of its length, tapering gradually anterior to base of esophagus. Cuticle very thick, smooth, 5-7 μ in the esophageal region, 7-11 μ near middle of body and 12-16 μ on tail. Lateral chords very distinct, 1/8th-1/7th of body-width near vulva. Lateral body pores about 200, arranged in a single row anterior to vulva and then irregularly arranged afterwards. Ventral body pores about 100, distributed at irregular intervals between base of mural tooth and anus. Dorsal body pores about fifteen, distributed irregularly between base of mural tooth and middle of esophagus. Lip region distinctly set off from the body, more than 1/3rd of body-width at base of esophagus. Amphids cup-like, their apertures about half of head-width wide. Sensillar pouches just below the base of

mural tooth, 16-20 μ from the level of amphidial slits.

Spear a mural tooth, 13-15 μ long, half as long as the head-width. Pharyngeal cavity 37-40 μ long, narrowing in posterior third of its length to join the esophageal lumen. Basal expanded portion of esophagus occupies about 2/3rd of the total esophageal length (in one paratype it is only slightly more than half the total length). Width of basal expanded portion more than half the width of body at base of esophagus, and 1/15th-1/12th of its total length. Only dorsal esophageal gland nucleus distinctly visible, situated 30 μ below its opening which is just at the junction of anterior slender part and expanded portion of esophagus. Esophago-intestinal disc present. Cardia conoid. Nerve ring 210-220 μ from anterior end. Intestine thick walled, lumen broad and containing remains of enchytraeids at places.

Vulva transverse; vagina about 1/3rd-1/2 body-width long. Uteri and oviduct nearly equal in length, each slightly less than thrice the body-width at vulva, and separated by a distinct sphincter. No sperms in uteri. Ovaries amphidelphic and reflexed, about 1/3rd way back to vulva. Oocytes arranged in a single row. Egg very small, measuring 38 x 26 μ, about one-third the corresponding body-width. Prerectum 190-240 μ long, about thrice the anal body-width. Rectum 80-100 μ long, about one and a half anal body-width. Tail hemispheroid, 38-45 μ long, less than one anal body-width. A pair of caudal pores visible with difficulty.

Male: Not found.

Habitat: Soil around roots of Gossypium herbaceum from Said Nagli, district Moradabad, U.P.

Type specimens: Collected in October, 1965; holotype mounted on slide MSJ/Sectonema procta/1; paratype females on slide MSJ/Sectonema procta/2.

Differential diagnosis: Sectonema procta n. sp., comes close to S. sica Clark, 1964 and S. macbethi Heyns, 1965. From S. sica it differs in having a slender body (a= 29 in S. sica); large number of lateral body pores (only 3 in S. sica); ventral pores about 100, dorsal pores about 15 (only 4 ventral and dorsal pores in S. sica); differently shaped lip region and mural tooth; shorter esophagus (b= 4.1); smaller egg (thrice the body-width in S. sica); posterior position of vulva (V= 40 in S. sica); longer rectum (only one anal body-width long in S. sica) and shorter and differently shaped tail. From S. macbethi it differs in having longer body (L= 3.81-4.06 mm.); more lateral body pores (115 in S. macbethi); presence of esophago-intestinal disc; absence of cuticularized pieces in vagina and shorter tail (c= 80-94 in S. macbethi).

KEY TO SPECIES OF SECTONEMA

(Modified after Heyns, 1965)

1. Body length more than 7 mm.....2

   Body length less than 6 mm.....4

2. Only male known; lateral pores less than 5.....
.....rotundicauda T. Goodey, 1951
Both males and females known; lateral pores more than 200.....3

3. Tail length at least 3/4th anal body-width; lips angular, as wide as adjoining body.....
.....ventrale Thorne, 1930
Tail length less than half anal body-width; lips rounded, narrower than adjoining body.....
.....brevicauda Heyns, 1965

4. Esophagus with an anterior spindle-shaped bulbus; oral aperture surrounded by setae.....barbatum Heyns, 1965
Esophagus without an anterior spindle-shaped bulbus; oral aperture without setae.....5

5. Oral aperture surrounded by small tubercles; tail conoid.....barbatoides Heyns, 1965
Oral aperture without tubercles; tail rounded or bluntly rounded.....6

6. Lip region about as wide as adjoining body; lips angular or subangular.....7
Lip region definitely narrower than adjoining body; lips rounded.....10

7. Length of mural tooth 1/3rd of head-width.....
.....pseudoventrale Heyns, 1965
Length of mural tooth more than 1/2 of head-width....8

8. Lateral body pores 3.....sica Clark, 1964
Lateral body pores more than 110.....9

9. Lateral body pores115; esophago-intestinal disc absent .....macbethi Heyns, 1965
   Lateral body pores 200; esophago-intestinal disc present.....procta n. sp.
10. Lip region three times as wide as high; tail hemispherical.....basilogoodeyi Heyns, 1965
    Lip region four times as wide as high; tail convex conoid.....macrospiculum (Altherr, 1955) Heyns, 1965

FAMILY LONGIDORIDAE (Thorne, 1935) Meyl, 1961

GENUS LONGIDORUS (Micoletzky, 1922) Filipjev, 1934

Several female specimens of Longidorus were collected from Uttar Pradesh. They represent the following species: Longidorus sylphus Thorne, 1939; L. laevicapitatus Williams, 1959 and L. brevicaudatus (Schuurmans Stekhoven, 1951) Thorne, 1961. Longidorus sylphus and L. laevicapitatus are hereby recorded for the first time from India.

Longidorus sylphus Thorne, 1939

Habitat: Six females from Gossypium herbaceum from Kailashpur, district Saharanpur, U.P.

Longidorus laevicapitatus Williams, 1959

Habitats: i) Four females from Gossypium herbaceum from Ahmadpur Brahman, district Saharanpur, U.P.

ii) Seven females from Hibiscus cannabinus from Chunar, district Mirzapur, U.P.

Longidorus brevicaudatus (Schuurmans Stekhoven, 1951) Thorne, 1961

The species is widely distributed in Uttar Pradesh and was found associated with all the 5 species of fibrous crops from the following districts: Agra, Allahabad, Aligarh,

Banaras, Bijnor, Bulandshahr, Etah, Etawah, Jalaun, Kanpur, Mainpuri, Mathura, Meerut, Mirzapur, Moradabad, Muzaffarnagar and Saharanpur.

GENUS XIPHINEMA Cobb, 1913

Xiphinema americanum Cobb, 1913

Habitats: i) Several females and 4 males from Gossypium herbaceum from Kanpur, Meerut and Saharanpur districts of U.P.

ii) Twelve females from Crotalaria juncea from Banaras and Mirzapur districts, U.P.

iii) Several females from Hibiscus cannabinus from Allahabad, Banaras and Ghazipur districts, U.P.

Xiphinema basiri Siddiqi, 1959

Habitat: Fifteen females from Crotalaria juncea from Barwe Sagar, district Jhansi, U.P.

GENUS PARALONGIDORUS Siddiqi et al., 1963

Paralongidorus citri (Siddiqi, 1959) Siddiqi et al., 1963

Habitats: i) Several females from Gossypium herbaceum from Allahabad, Bulandshahr, Kanpur, Meerut and Saharanpur districts of U.P.

ii) Six females from Gossypium arboreum from Badaun, U.P.

iii) Nineteen females from Hibiscus cannabinus from Jalaun and Mirzapur districts, U.P.

Paralongidorus microlaimus Siddiqi, 1964

Habitat: Eight females from *Gossypium herbaceum* from Modipur, district Saharanpur, U.P.

FAMILY LEPTONCHIDAE Thorne, 1935

GENUS LEPTONCHUS Cobb, 1920

Leptonchus granulosus Cobb, 1920

Habitats: i) Several females collected from Gossypium herbaceum from Bijnor, Bulandshahr, Etah, Etawah, Meerut, Moradabad, Muzaffarnagar, Saharanpur and Shahjahanpur districts of U.P.

ii) Eight females from Crotalaria juncea from Mirzapur district, U.P.

Leptonchus capitatus n. sp.

(Plate: XXII, Figs.H-K)

Dimensions:

Females (7): L= 1.21 mm. (0.91-1.42 mm.); a= 33 (29-39); b= 5.2 (4.4-5.8); c= 52 (45-60); $V = \frac{13}{58}\ (\frac{12}{55\text{-}62})\ \frac{12\text{-}14}{11\text{-}13}$.

Female (holotype): L= 1.23 mm.; a= 32; b= 5.4; c= 59; $V = \frac{14}{58}\ \frac{12}{}$.

Description:

. Female: Body tapering gradually anterior to slender part of esophagus and curved posterior to vulva. Cuticle 2 μ thick at head and 4-6 μ on tail, smooth. Subcuticle irregularly loosened, striated. Lip region cap-like, well

set off from body. Labial papillae visible. Lateral hypodermal chords 1/9th-1/6th of body-width near middle. Lateral, dorsal and ventral body pores not seen. Amphids cup-shaped, their apertures 4 μ from anterior end, 6 μ or more than half the corresponding body-width wide. Sensillar pouches 17-18 μ from amphidial slits.

Spear slender, narrow, 9-10 μ or about one head-width long. Spear extensions arcuate, cuticularized, about as long as spear. Spear guiding ring 5-6 μ from anterior end. Basal esophageal bulb occupies 17-21% of total esophageal length, its width about half of the body-width at base of esophagus and about two to three times of its own length. Opening of dorsal esophageal gland 160-202 μ or 80-86% of the esophageal length from anterior end. The subventral pair of esophageal glands open 8-12 μ below the dorsal esophageal gland opening. Nerve ring 85-94 μ from anterior end. Cardia hemispheroid.

Vulva a transverse slit, not bordered by fringed membranes. Vagina 9-13 μ or 1/4th-1/2 across the body. Gonads amphidelphic. Combined length of oviduct and uterus 155-192 μ and 149-172 μ of anterior and posterior gonads respectively. Oocytes arranged in a single row except at the tip. Ovaries with single flexure. Sperms not seen in uteri. Prerectum 155-204 μ, 12-15% of total body length or six to eight anal body-widths long. Rectum 19-24 μ, about one anal body-width long. Tail 21-30 μ, hemispheroid,

about one anal body-width long. Two minute caudal pores present.

Male: Not found.

Habitat: Soil around roots of Gossypium hirsutum from Lalu Kheri, district Muzaffarnagar, U.P.

Type specimens: Collected in October, 1966; holotype mounted on slide MSJ/Leptonchus capitatus/1; 7 paratypes on slide MSJ/Leptonchus capitatus/2.

Differential diagnosis: Leptonchus capitatus n. sp., comes close to Leptonchus obtusus Thorne, 1939 but differs in having a shorter body length (L= 1.6 mm. in L. obtusus); wider amphids; longer basal bulb and differently shaped tail.

KEY TO SPECIES OF LEPTONCHUS

(Modified after Loof, 1963)

1. Inner circle of papillae on a distinct rostrum-like structure.....dicephalus Yeates, 1967
   Inner circle of papillae not so distinctly set off.....2
2. Vulva bordered by fringed membranes.....
   .....fimbriatus Thorne, 1939
   Vulva not bordered by fringed membranes.....3
3. Prerectum extending anterior to vulva.....4
   Prerectum not extending anterior to vulva.....5

4. Cuticle with conspicuous refractive elements.....
.....scintillans Loof, 1963
Cuticle without refractive elements.....
.....granulosus Cobb, 1920

5. V= 41-42.....multipapillatus Meyl, 1956
V= over 50.....6

6. Prerectum 12 anal body-widths long.....
.....transvaalensis Heyns, 1963
Prerectum less than 8 anal body-widths long.....7

7. Prerectum 4 anal body-widths long; c= more than 75.....
.....paucipapillatus Meyl, 1956
Prerectum more than 6 anal body-widths long; c= less than 60.....8

8. Body 1.6 mm. long; tail convex-conoid.....
.....obtusus Thorne, 1939
Body 0.91-1.42 mm. long; tail hemispheroid.....
.....capitatus n. sp.

GENUS PROLEPTONCHUS Lordello, 1955

Proleptonchus aestivus Lordello, 1955

Habitat: Six females from Gossypium herbaceum from Saharanpur district, U.P.

A large number of specimens of Dorylaimoides Thorne and Swanger, 1936 and a closely related new genus Morasia* was obtained during the course of investigations from Uttar Pradesh. The Dorylaimoides populations represent D. arcuatus Siddiqi, 1963; D. parateres Siddiqi, 1963 and 3 new species described below as D. constrictus, D. grandis and D. arcuicaudatus. Males of D. arcuatus and D. parateres are hereby recorded for the first time.

GENUS DORYLAIMOIDES Thorne and Swanger, 1936

Dorylaimoides arcuatus Siddiqi, 1963

(Plate: XXIII, Figs. D-J)

Dimensions:

i) Singhpur population: Females (10): L= 0.90 mm. (0.81-0.96 mm.); a= 44 (39-48); b= 5.8 (5.1-6.3); c= 16 (14-17); V= 3.5 (14) 3-4 (33-37) 10-17.

Males (5): L= 0.83 mm. (0.75-0.86 mm.); a= 41 (39-44); b= 5.6 (5.2-5.9); c= 17 (16-18); T= 55 (53-58).

ii) Paras-Ka-Banglaw population: Females (10): L= 0.89 mm. (0.79-0.94 mm.); a= 39 (35-45); b= 6.2 (5.3-7.0); c= 16 (13-20); V= 2.5 (15) 2.0-3.5 (33-37) 13-17.

Males (5): L= 0.80 mm. (0.75-0.89 mm.); a= 41 (38-45); b= 5.5 (5.1-6.0); c= 15 (14-17); T= 55 (52-56).

iii) Shairpur population: Females (10): L= 0.90 mm. (0.78-1.02 mm.); a= 44 (40-51); b= 5.9 (5.2-6.7); c= 16 (14-18); V= 3 (15) 2.5-4 (32-37) 13-17.

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*Named after Dr. Mohd. Rafiq Siddiqi, Nematologist, Commonwealth Bureau of Helminthology, Herts, England.

Males (4): L= 0.75-0.94 mm.; a= 41-49; b= 5.1-6.3; c= 16-17; T= 51-57.

Description:

(The description of D. arcuatus by Siddiqi (1963) is based on a single female specimen. It, therefore, seems quite justified to give a detailed description of females as well as males which are recorded here for the first time).

Female: Body curved in posterior half of its length upon fixation and tapering gradually anterior to slender part of esophagus. Cuticle and subcuticle finely striated. Lateral hypodermal chords 1/6th-1/5th of body-width near middle. Head set off by depression, about 1/3rd of body-width at base of esophagus. Amphids cup-shaped, apertures 3-4 μ from anterior end and about 3/4th the corresponding body-width wide. Sensillar pouches 15-17 μ from amphidial slit.

Spear measuring 4-5 u ventrally and 6-7 μ dorsally, about one head-width long; its aperture about 2 μ. Spear guiding ring 4-5 μ from anterior end. Spear extensions 10-12 μ long. Basal expanded portion of esophagus 24-30% of the total esophageal length. Dorsal esophageal gland opening 110-120 μ or 75-80% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 12-16 μ from dorsal esophageal gland opening and the second pair opens 8-11 μ below the opening of the first pair.

Nerve ring 70-80 μ from anterior end. Cardia rounded.

Vulva a transverse slit. Vagina 8-11 μ, extending about 1/2 across the body. Anterior uterine sac 1.0-2.5 of the corresponding body-width. Posterior sexual branch 122-160 μ long. Ovary reflexed, oocytes arranged in a single row except at tip. Prerectum 5-7 anal body-widths long. Tail ventrally arcuate, regularly tapering, 3.5-5.5 anal body-widths long. Two minute caudal pores present.

Male: Supplements an adanal pair and 3-5 ventromedian, the latter begin about 1.5 anal body-width above the anus, spaced at irregular intervals. Spicules 20-22 μ medially. Lateral guiding pieces obscure. Tail as of female.

Habitats: Singhpur and Shairpur populations: Soil around roots of Gossypium herbaceum from Singhpur, district Moradabad, and Shairpur, district Etawah, U.P.

Paras-Ka-Banglaw population: Soil around roots of Crotalaria juncea from Paras-Ka-Banglaw, district Kanpur, U.P.

Additional localities: Few females and males were also collected from Allahabad, Bulandshahr, Meerut and Muzaffar-nagar districts of U.P.

Dorylaimoides parateres Siddiqi, 1963

(Plate: XXIII, Figs. A-C)

Dimensions:

Females (2): L= 1.27-1.47 mm.; a= 37-40; b= 6.1-7.2; c= 47-50; V= $\frac{11}{43-48}$ $\frac{}{10-12}$.

Males (2): L= 1.27-1.45 mm.; a= 40-44; b= 5.9-6.0; c= 45-47; T= 59-62.

Description:

Female: Body curved in posterior half of its length. Cuticle 2-6 μ thick at various places in body (thickest on tail). Head slightly set off, about 1/3rd the body-width at base of esophagus. Lateral hypodermal chords about 1/7th the body-width near middle. Amphids large, stirrup-shaped.

Spear cylindrical, 10-12 μ long. Spear extensions 15-16 μ long. Basal expanded portion of esophagus 26-30% of total esophageal length. Nerve ring 82-94 μ from anterior end. Cardia rounded.

Vulva a transverse slit. Gonads amphidelphic. Oviduct and uterus separated by sphincter. Prerectum 6-7 anal body-widths long. Tail bluntly rounded.

Male: (Males are hereby recorded for the first time for this species). Supplements an adanal pair and 7 ventro-medians, the latter begin slightly more than one anal body-width above the anus. Spaced at irregular intervals. Spicules 35-36 μ long medially. Lateral guiding pieces obscure. Tail 1.0-1.5 anal body-widths long, rounded.

Habitat: Soil around roots of Crotalaria juncea from Gyanpur, district Banaras, U.P.

Dorylaimoides constrictus n. sp.

(Plate: XXIV)

Dimensions:

Females (4): L= 0.82-0.85 mm.; a= 38-40; b= 6.2-7.0; c= 7-9; V= $\frac{2.5\text{-}4.5}{31\text{-}33}$ $\frac{11\text{-}16}{\ }$.

Female (holotype): L= 0.90 mm.; a= 43; b= 7.0; c= 8.0; V= $\frac{3.5}{30}$ $\frac{11}{\ }$.

Males (3): L= 0.80-0.86 mm.; a= 41-44; b= 6.0-7.0; c= 9-10; T= 50-53.

Description:

Female: Body curved in posterior half of its length upon fixation and tapering gradually anterior to slender part of esophagus. Cuticle finely striated, 1-2 μ thick. Subcuticle with faint striations, less than 1 μ thick. Lateral hypodermal chords 1/6th-1/5th body-width near middle. Head slightly set off by a depression, about 1/3rd body-width at base of esophagus. Amphids cup-shaped, apertures 3-4 μ from anterior end, 4-5 μ or about 3/4th the corresponding body-width. Sensillar pouches 13-14 μ from amphidial slits.

Spear measures 4-5 μ ventrally and 6-7 μ dorsally, its aperture 2 μ. Spear guiding ring single, 4-5 μ from anterior end. Spear extensions 9-11 μ long. Basal expanded portion of esophagus set off from anterior slender part by a constriction; 23-26% of the total esophageal length, its width slightly more than 1/2 the body-width at base of esophagus

and about 1/4th-1/3rd of its own length. Opening of dorsal esophageal gland 103-119 μ or 78-82% of esophageal length from anterior end. The first pair of subventral esophageal glands open 7-13 μ from dorsal esophageal gland opening and the second pair opens 7-11 μ below the opening of the first pair. Nerve ring 62-70 μ from anterior end. Cardia rounded.

Vulva a transverse slit. Vagina 9-11 μ, extending about 1/2 the corresponding body-width. Gonad single, opisthodelphic. Anterior uterine sac about 1-2 corresponding body-widths long. Posterior sexual branch measures 108-145 μ. Oviduct and uterus distinctly separated by sphincter. Ovary reflexed, oocytes arranged in a single row except at tip. Prerectum 63-80 μ or 5-6 anal body-widths long. Rectum slightly more than one anal body-width long. Tail long, filiform, 7-9 anal body-widths long. Caudal pores observed.

Male: Supplements an adanal pair and 3 ventromedians, the latter begin slightly above the proximal end of the spicules, spaced at irregular intervals. Spicules 19-20 μ long medially. Lateral guiding pieces obscure. Tail filiform, about 6 anal body-widths long.

Habitat: Soil around roots of Crotalaria juncea from Gyanpur, district Banaras, U.P.

Type specimens: Collected in October, 1967; holotype mounted on slide MSJ/Dorylaimoides constrictus/1 and paratypes on slide MSJ/Dorylaimoides constrictus/2.

Differential diagnosis: Dorylaimoides constrictus n. sp., comes close to Dorylaimoides brevidens Thorne, 1964 and Dorylaimoides longiurus Siddiqi, 1965. From the former it differs in the shape of lip region, amphids and spear; in having expanded portion of esophagus regular in contour (irregular in D. brevidens); shorter esophagus (b= 5.5 in D. brevidens) and absence of spermatheca. From D. longiurus it differs in the shape of lip region and spear; in having a constriction at the junction of anterior slender part and basal expanded portion of esophagus; longer prerectum (3.0-3.5 anal body-widths in D. longiurus); shorter and differently shaped spicules (23-24 μ in D. longiurus).

Dorylaimoides grandis n. sp.

(Plate: XXV, Figs.G-K)

Dimensions:

i) Disond Hakimpur population (Type population):

Females (3): L= 0.80-0.90 mm.; a= 36-39; b= 5.4-6.3; c= 9-11; V= $\frac{2.5\text{-}4.0}{31\text{-}33}$ $\frac{13\text{-}16}{}$.

Female (holotype): L= 0.90 mm.; a= 37; b= 5.1; c= 11; V= $\frac{2.6}{33}$ $\frac{16}{}$.

Males (2): L= 0.88-0.95 mm.; a= 35-44; b= 6.2-6.5; c= 12-13; T= 53-54.

ii) Sakrar population: Male (1): L= 0.84 mm.; a= 43; b= 5.9; c= 10; T= 50.

Description:

Female: Body curved in posterior half of its length upon fixation and tapering gradually anterior to slender part of esophagus. Cuticle and subcuticle finely striated. Lateral hypodermal chords 1/6th-1/5th body-width near middle. Head slightly set off, about 1/3rd body-width at base of esophagus. Amphids cup-shaped, apertures 4 μ from anterior end, its width 4-5 μ or about 3/4th the corresponding body-width. Sensillar pouches 15-16 μ from amphidial slits.

Spear measures 7 μ ventrally and 9-10 μ dorsally, more than one head-width long, its aperture 2 μ. Spear guiding ring 4-5 μ from anterior end. Spear extensions 12-13 μ long. Basal expanded portion of esophagus 22-25% of the total esophageal length, its width 1/2-1/2.5 body-width at base of esophagus and 1/5th-1/4th of its own length. Opening of dorsal esophageal gland 110-137 μ or 77-81% of esophageal length from anterior end. The first pair of subventral esophageal glands open 8-10 μ from the dorsal esophageal gland opening and the second pair opens 9-12 μ below the opening of the first pair. Nerve ring 80-90 μ from anterior end. Cardia rounded.

Vulva a transverse slit. Vagina 10-12 μ, extending slightly less than 1/2 across the body. Gonad single, opisthodelphic. Anterior uterine sac 1-2 body-widths long. Posterior sexual branch 120-160 μ long. Oviduct and uterus distinctly separated by sphincter. Ovary reflexed, oocytes

arranged in double rows. Prerectum 80-107 μ or 5-7 anal body-widths long. Rectum about one anal body-width long. Tail uniformly tapering, 5-6 anal body-widths long. Two minute caudal pores present.

Male: Supplements an adanal pair and 2-3 ventromedians, the latter begin 2 anal body-widths above the anus, spaced at irregular intervals. Spicules 19-22 μ medially. Lateral guiding pieces obscure. Tail about 5 anal body-widths long.

Habitat: Disond Hakimpur population (Type): Soil around roots of Gossypium herbaceum from Disond Hakimpur, district Bijnor, U.P.

Sakrar population: Single male was collected from soil around roots of Crotalaria juncea from Sakrar, district Jhansi, U.P.

Type specimens: Collected in November, 1966; holotype along with one paratype male mounted on slide MSJ/Dorylaimoides grandis/1; paratypes on slide MSJ/Dorylaimoides grandis/2. Specimen from Sakrar mounted on slide MSJ/Dorylaimoides grandis/3.

Differential diagnosis: Dorylaimoides grandis n. sp., comes close to Dorylaimoides paraconurus Heyns, 1963 and Dorylaimoides longiurus Siddiqi, 1965. From the former it differs in having shorter body (L= 1.30-1.40 mm. in D. paraconurus); smaller basal expanded portion of esophagus (more than 50% in D. paraconurus); differently shaped

amphids; longer anterior uterine sac (about 1/2 the body-width in D. paraconurus); longer prerectum (1.5-2.0 anal body-widths long in D. paraconurus). From D. longiurus it differs in the shape of lip region and spear; in having more than one head-width long spear (less than 1/2 head-width in D. longiurus); longer prerectum (3.0-3.5 anal body-widths long in D. longiurus); shorter tail (11 anal body-widths long in D. longiurus).

Dorylaimoides arcuicaudatus n. sp.

(Plate: XXV, Figs. A-F)

Dimensions:

Females (4): L= 1.24-1.40 mm.; a= 31-36; b= 7.4-8.0; c= 27-29; V= $\frac{12\text{-}13}{44\text{-}48}$ $\frac{11\text{-}13}{\ }$.

Female (holotype): L= 1.28 mm.; a= 37; b= 7.1; c= 29; V= $\frac{12}{49}$ $\frac{12}{\ }$.

Males (2): L= 1.30-1.41 mm.; a= 37-38; b= 7.0-8.1; c= 26-31; T= 54-59.

Description:

Female: Body 'C' shaped upon fixation and tapering gradually anterior to slender part of esophagus. Cuticle finely striated, its thickness varies between 1-4 μ at various places in body (3-4 μ thick on tail). Subcuticle with faint striations, less than 1 μ thick. Lateral hypodermal chords 1/7th-1/5th body-width near middle. Head set off, 1/5th-1/4th body-width at base of esophagus. Amphids cup-shaped,

apertures 3-4 μ from anterior end, its width 5-6 μ or about 3/4th the corresponding body-width. Sensillar pouches 20-22 μ from amphidial slits.

Spear measures 7-10 μ ventrally and 10-13 μ dorsally, about 1.5 head-width long, its aperture 1/4th of its length. Spear guiding ring 6-7 μ from anterior end. Spear extensions 15-16 μ long. Basal expanded portion of esophagus 27-34% of the total esophageal length, its width about 1/3rd body-width at base of esophagus and 1/6th-1/5th of its own length. Opening of dorsal esophageal gland 126-144 μ or 72-79% of esophageal length from anterior end. The first pair of subventral esophageal glands open 13-16 μ from dorsal esophageal gland opening and the second pair opens 7-11 μ below the opening of the first pair. Nerve ring 86-93 μ from anterior end. Cardia rounded.

Vulva a transverse slit. Vagina 17-19 μ, extending 1/3rd-1/2 across the body. Gonads amphidelphic. Oviduct and uterus distinctly separated by a sphincter. Anterior sexual branch 170-195 μ and posterior 168-192 μ long. Ovaries reflexed, oocytes arranged in a single row except at tip. Prerectum 110-117 μ, about 6 anal body-widths long. Tail conoid, ventrally curved with rounded terminus, about 2.5 anal body-widths long. Two minute caudal pores present.

Male: Supplements an adanal pair and 5 ventromedians, the latter begin at about one anal body-width above the anus

and spaced at irregular intervals. Spicules 37-40 μ medially. Lateral guiding pieces obscure. Tail 2.0-2.5 anal body-widths long.

Habitat: Soil around roots of Hibiscus cannabinus from Karganwan, district Jhansi, U.P.

Type specimens: Collected in October, 1967; holotype mounted on slide MSJ/Dorylaimoides arcuicaudatus/1; paratypes on slides MSJ/Dorylaimoides arcuicaudatus/2-3.

Differential diagnosis: Dorylaimoides arcuicaudatus n. sp., comes close to Dorylaimoides elegans (de Man, 1880) Thorne and Swanger, 1936 and Dorylaimoides micoletzkyi (de Man, 1921) Thorne and Swanger, 1936. From the former it differs in shape of amphids, spear and tail; in having a smaller esophagus (b= 5.9 in D. elegans) and different arrangement of ventromedian supplements. From D. micoletzkyi it can be distinguished in having set off lip region; shorter esophagus (b= 6.3 in D. micoletzkyi); longer spear, differently shaped tail and the arrangement of the ventromedian supplements.

The latest key to the species of the genus Dorylaimoides is by Siddiqi (1963). The latter author has included 18 species in the key. Since then several species of Dorylaimoides have been described: 4 Thorne (1964), one Loof (1964), 2 Timm (1964), one Szczygiel (1965), 4 Siddiqi (1965), one Jairajpuri (1965), 4 Sauer (1966) and 2 Husain and Khan (1968). In the present work 3 new species have been described and one has

been shifted to a closely related new genus, Morasia. The presentation of an emended key is therefore inevitable.

KEY TO SPECIES OF DORYLAIMOIDES

1. Ovary single.....2
   Ovaries two.....20
2. Tail less than one and a half anal body-widths long...3
   Tail 3 or more anal body-widths long.....6
3. Tail digitate, dorsally convex-conoid.....
   .....dactylurus Heyns, 1963
   Tail bluntly conoid.....4
4. Lip region continuous, anterior slender part and basal expanded portion of esophagus not set off by constriction.....pretoriensis Heyns, 1963
   Lip region distinctly set off; anterior slender part and basal expanded portion of esophagus set off by a constriction.....5
5. Spear almost straight, prerectum more than 9 anal body-widths long.....mitis Sauer, 1966
   Spear curved; prerectum less than 6 anal body-widths long.....angustus Sauer, 1966
6. Vulva less than 3 body-widths posterior to base of esophagus.....conurus Thorne, 1939
   Vulva more than 6 body-widths posterior to base of esophagus.....7

7. Anterior slender part and basal expanded portion of esophagus set off by constriction.....8
Anterior slender part and basal expanded portion of esophagus not set off by constriction.....9

8. Lip region continuous; basal expanded portion of esophagus irregular in contour; spermatheca present.....
.....brevidens Thorne, 1964
Lip region set off; basal expanded portion of esophagus smooth in contour; spermatheca absent.....
.....constrictus n. sp.

9. Lip region cap-like; amphidial apertures occupy about 90% of the corresponding body-width.....
.....rusticus Timm, 1964
Lip region not cap-like; amphidial apertures occupy about 75% or less of the corresponding body-width...10

10. Spear more than 1.4 head-width long.....11
Spear one head-width long or less.....13

11. Lips angular; head set off by a deep constriction.....
.....reversus Thorne, 1964
Lips amalgamated; head set off by a slight depression.
.....12

12. Basal expanded portion of esophagus about 50% of esophageal length.....paraconurus Heyns, 1963
Basal expanded portion of esophagus about 25% of esophageal length.....grandis n. sp.

13. Tail 11 anal body-widths long..longiurus Siddiqi, 1965
Tail less than 6 anal body-widths long.....14

14. Anterior uterine sac absent....riparius Andrássy, 1962
Anterior uterine sac present.....15

15. Tail ventrally arcuate.....16
Tail convex-conoid, posterior end bent dorsally.....17

16. Prerectum 5-6 anal body-widths long.....
.....arcuatus Siddiqi, 1963
Prerectum one anal body-width long.....
.....elongatus Husain and Khan, 1968

17. Spear extensions forming pharyngeal cavity.....
.....intermedius Thorne, 1964
Spear extensions not forming pharyngeal cavity.....18

18. Spear straight; lip region continuous.....
.....modestus Siddiqi, 1965
Spear curved; lip region slightly set off by a depression.....19

19. Spear about one head-width long.....
bulbosus (Brezeski and Szczygiel, 1961) Szczygiel,1965
Spear about half head-width long.....
.....venustus Andrássy, 1959

20. Tail round or short bluntly-conoid.....21
Tail elongate-conoid or filiform.....26

21. Anterior slender part and basal expanded portion of esophagus set off by constriction.....22
Anterior slender part and basal expanded portion of esophagus not set off by constriction.....23

22. Spear narrow, almost straight.....websteri Sauer, 1966
Spear broad, curved.....buccinator Sauer, 1966

23. Vulva at about 60%.....thecolaimus Heyns, 1963
Vulva at less than 50%.....24

24. Spear diverging at base; tail bluntly-conoid.....
.....teres Thorne and Swanger, 1936
Spear straight; tail rounded.....25

25. Spear 10-12 μ long; basal expanded portion 1/4th the total esophageal length.....parateres Siddiqi, 1963
Spear 7 μ long; basal expanded portion about 1/3rd the total esophageal length.....indicus Jairajpuri, 1965

26. Tail less than 2.5 anal body-widths long.....27
Tail more than 4 anal body-widths long.....29

27. Tail digitate, posterior end bent dorsally.....
...micoletzkyi (de Man, 1921) Thorne and Swanger, 1936
Tail subdigitate or ventrally arcuate.....28

28. Tail ventrally arcuate; spear straight.....
.....arcuicaudatus n. sp.
Tail subdigitate; spear diverging at base.....
.....elegans (de Man, 1880) Thorne and Swanger, 1936

29. Tail elongate-conoid.....30
Tail long, filiform.....33

30. Lateral hypodermal chords with glandular organs; vulva at 35%.....similis Thorne, 1964
Lateral hypodermal chords without glandular organs; vulva at more than 40%.....31

31. Spear about 1.5 head-width long.....porifer Loof, 1964
Spear about one head-width long.....32

32. Prerectum 5 anal body-widths long; post-anal intestinal sac absent.....pakistanensis Siddiqi, 1963
Prerectum about 2 anal body-widths long; post anal intestinal sac present....leptus Husain and Khan, 1968

33. Tail more than 12 anal body-widths long.....
longicaudatus (Imamura, 1931) Thorne and Swanger, 1936
Tail less than 9 anal body-widths long.....34

34. Spear straight.....35
Spear arcuate or asymmetrical.....36

35. Spear robust; body length 1.90-2.02 mm.....
.....leptura Siddiqi, 1965
Spear not robust; body-length 0.97-1.25 mm.....
.....elaboratus Siddiqi, 1965

36. Ventromedian supplements 9-11.....lepidus Timm, 1964
Ventromedian supplements 3-6.....37

37. Spear 3/4th head-width long....paulbuchneri Meyl, 1956
Spear more than one head-width long.....
.....parvus Thorne and Swanger, 1936

GENUS MORASIA n.gen.

Diagnosis: Leptonchidae. Same as Dorylaimoides except for dissimilar tail of sexes, elongate-conoid in female and bluntly rounded in male.

Type species: Morasia dimorphicauda n. sp.

Other species: M. rhabdotus (Kreis, 1930) n. comb.
syn. Dorylaimoides rhabdotus (Kreis, 1930) Thorne and Swanger, 1936

Morasia dimorphicauda n. sp.

(Plate: XXVI)

Dimensions:

i) Bhognipur population (Type population): Females (7): $\overset{9-13}{L}$= 1.53-1.91 mm.; a= 35-45; b= 6.2-8.3; c= 23-31; $\overset{9-13}{V}$= 42-47.

Female (holotype): L= 1.78 mm.; a= 39; b= 6.9; c= 28; $\overset{13}{V}$= $\overset{14}{45}$.

Males (4): L= 1.60-1.79 mm.; a= 41-49; b= 6.5-6.8; c= 45-51; T= 50-55.

ii) Bamanheri population: Females (2): L= 1.70-1.78 mm.; a= 42-44; b= 6.9-7.0; c= $\overset{10}{28-31}$; V= $\overset{10-11}{43-45}$.

Males (2): L= 1.60-1.79 mm.; a= 43-44; b= 6.4-7.2; c= 43-45; T= 56-59.

iii) Deoband population: Females (2): L= 1.67-1.80 mm.; a= $\overset{12-17}{35-40}$; b= 6.8-7.2; c= $\overset{12-18}{21-30}$; V= 43-44.

Description:

Female: Body curved in posterior half of its length upon fixation and tapering gradually anterior to slender part of esophagus. Cuticle finely striated, its thickness varies between 2-6 μ at various places in the body (4-6 μ on tail). Subcuticle with faint striations, less than 1 μ thick. Lateral hypodermal chords 1/10-1/6th (averaging 1/7th) of body-width near middle. Glandular organs conspicuous, 57-70 in number, variable in size and irregular in arrangement. Head slightly set off by a depression,

1/4th-1/3rd of body-width at base of esophagus. En face view showing six small lips of equal size each having an inner and an outer cephalic papillae. The four additional papillae which are usually present on the submedian lips imperceptible. Amphids cup-shaped, apertures 4-5 μ from anterior end, 7-8 μ or about 3/4th the corresponding body-width wide. Sensillar pouches 16-19 μ from amphidial slits.

Spear measures 7-9 μ ventrally and 11-13 μ dorsally, its aperture 3-4 μ. Spear guiding ring single, 6-8 μ from anterior end. Spear extensions curved, 17-20 μ. Basal expanded portion of esophagus 27-30% of the total esophageal length, its width less than 1/3rd of body-width at base of esophagus and 1/6th-1/5th of its own length. Opening of dorsal esophageal gland 176-214 μ or 72-78% of esophageal length from anterior end. The first pair of subventral esophageal glands open 12-19 μ from dorsal esophageal gland opening and the second pair opens 12-18 μ below the opening of the first pair. Nerve ring 100-124 μ from anterior end. Esophago-intestinal disc present. Cardia rounded.

Vulva a transverse slit. Vagina 19-24 μ long, extending about 1/2 across the body. Gonads amphidelphic. Oviduct and uterus distinctly separated by sphincter. Anterior sexual branch 163-318 μ and posterior 158-302 μ long. Uteri filled with sperms. Ovaries reflexed, oocytes arranged in a single row except at tip. Size of egg 114-118 x 27-37 μ. Prerectum 200-253 μ or about 7-9 times the anal body-width.

Rectum about one anal body-width long. Tail 2.0-2.5 anal body-widths long, elongate-conoid with rounded terminus. Two minute caudal pores present.

Male: Supplements an adanal pair and 6-7 ventromedians, the latter begin at about 1.5 anal body-widths above the anus and spaced at somewhat irregular intervals. Spicules 36-40 μ long medially, about 1.5 anal body-widths long. Lateral guiding pieces obscure and difficult to measure. Tail rounded, about 1.5 anal body-widths long.

Habitat: Bhognipur population (Type): Soil around roots of Gossypium arboreum from Bhognipur, district Kanpur, U.P.

Bamanheri and Deoband populations: Soil around roots of Gossypium herbaceum from Bamanheri, district Muzaffar-nagar and Deoband, district Saharanpur, U.P.

Type specimens: Collected in October, 1967; holotype along with one paratype male mounted on slide MSJ/Morasia dimorphicauda/1; paratypes on slides MSJ/Morasia dimorphicauda/2-3. Specimens from Bamanheri and Deoband are mounted on slides MSJ/Morasia dimorphicauda/4-5.

Differential diagnosis: Morasia dimorphicauda n. sp., differs from the only other species of the genus Morasia rhabdotus (Kreis, 1930) n. comb. in having longer body (1.05 mm. in M. rhabdotus); presence of glandular organs in the lateral hypodermal chords; tail shapes and longer and differently shaped spicules (about one anal body-width long in M. rhabdotus).

GENUS TYLENCHOLAIMELLUS N.A. Cobb in M.V. Cobb, 1915

Tylencholaimellus eskei Siddiqi and Khan, 1964

Habitat: Seven females from Gossypium herbaceum from Meerut and Muzaffarnagar districts, U.P.

Tylencholaimellus sayeedi Siddiqi, 1965

Habitat: Twenty five females were collected from Gossypium arboreum from Rampur district, U.P.

GENUS TYLENCHOLAIMUS de Man, 1876

Tylencholaimus minimus de Man, 1876

Habitats: i) Six females from Gossypium herbaceum from Muzaffarnagar, U.P.

ii) Several females from Crotalaria juncea from Jhansi, Kanpur and Mirzapur districts, U.P.

Tylencholaimus leptonchoides Loof, 1964

Habitat: Ten females were collected from Gossypium herbaceum from Bulandshahr and Etawah districts, U.P.

Tylencholaimus obscurus Jairajpuri, 1965

Habitats: i) Fifteen females from Gossypium hirsutum from Aligarh, U.P.

ii) Several females from Gossypium herbaceum from Badaun, Etah, Mainpuri, Meerut, Muzaffarnagar and Saharanpur districts, U.P.

iii) Five females from Gossypium arboreum from Agra district, U.P.

iv) Several females from Crotalaria juncea from Banaras, Ghazipur and Jhansi districts, U.P.

GENUS TYLEPTUS Thorne, 1939

Tyleptus variabilis Jairajpuri and Loof, 1966

Habitat: Seven females from Gossypium arboreum from Badaun and Moradabad districts, U.P.

FAMILY BELONENCHIDAE Thorne, 1964

GENUS BASIROTYLEPTUS Jairajpuri, 1964

Basirotyleptus basiri Jairajpuri, 1964

Habitats: i) Several females from Gossypium herbaceum from Kanpur and Meerut districts, U.P.

ii) Over fifty females from Crotalaria juncea from Jhansi district, U.P.

SUPERFAMILY BELONDIROIDEA (Thorne, 1939) Thorne, 1964

A large number of specimens of Belondiroidea was collected from soil around roots of fibrous crops. They represent one species of Belondira Thorne, 1939; 3 species of Oxydirus Thorne, 1939 and 8 known and 2 new species of Dorylaimellus Cobb, 1913. Oxydirus oxycephalus (de Man, 1885) Thorne, 1939, O. magnus Timm, 1964 and Dorylaimellus projectus Heyns, 1962 are here recorded for the first time from India.

FAMILY BELONDIRIDAE Thorne, 1939

GENUS BELONDIRA Thorne, 1939

Belondira paraclava Jairajpuri, 1964

Siddiqi (1966) listed this species as a synonym of Belondira caudata Thorne, 1939 without mentioning reasons for his action. A study of the type material and several fresh specimens collected from the type locality as well as from other localities clearly shows that B. paraclava is distinctly different from B. caudata in shape of tail which has its outer cuticle greately swollen to give it a clavate appearance. Belondira paraclava is therefore regarded as a valid species and not a synonym of B. caudata as was proposed by Siddiqi.

Habitats: i) Several females from Gossypium herbaceum from Etawah, Muzaffarnagar, Rampur and Saharanpur districts of U.P.

ii) Twenty five females from Crotalaria juncea from Banaras, Jalaun, Jhansi and Mirzapur districts of U.P.

FAMILY OXYDIRIDAE Thorne, 1964

GENUS OXYDIRUS Thorne, 1939

Oxydirus oxycephalus (de Man, 1885) Thorne, 1939

Habitat: Fifteen females were collected from Crotalaria juncea from Srinagar, Kashmir.

Oxydirus magnus Timm, 1964

(Plate: XXVII, Figs. G-I)

Dimensions:

Female (1): L= 4.2 mm.; a= 72; b= 13.5; c= 16; V= 41; spear= 10 µ; spear extensions= 10 µ.

(After Timm, 1964):

Females (6): L= 4.85-5.72 mm.; a= 85-117; b= 13.2-17.1; c= 12-15; V= 33-40.

Males (6): L= 4.43-4.94 mm.; a= 87-103; b= 14.0-15.4; c= 17-21.

Spear= 9 µ; spear extensions= 10 µ; ventromedian supplements= 12-16; spicules 54-57 µ.

Habitat: Single female was collected from soil around roots of Crotalaria juncea from Aurai, district Banaras, U.P.

Oxydirus gigas* Jairajpuri, 1964

(Plate: XXVII, Figs. J-L)

syn. Oxydirus magnus apud Siddiqi, 1966

Siddiqi (1966) doubtfully synonymised this species with O. magnus Timm, 1964. Incidently, the description of both O. magnus and O. gigas appeared in the same issue of the journal, the former having page priority. However, comparison of the type specimens of both these species and some fresh specimens recently collected clearly revealed that the two species are distinctly different in a number of characters. The dimensions and differential characters of these two species are as follows. The male specimen of Oxydirus identified as O. magnus by Siddiqi (1966) belongs under O. gigas.

Dimensions:

Oxydirus gigas (Jogipura population):

Female (1): L= 3.89 mm.; a= 70; b= 12.8; c= 9; V= 39.

Males (2): L= 3.62-3.72 mm.; a= 84-86; b= 12.0-12.2; c= 10-15.

Spear= 5-7 µ; spear extensions= 8-10 µ; ventromedian supplements= 13; spicules 48-51 µ.

Oxydirus gigas (after Jairajpuri, 1964):

Males (2): L= 3.7-4.3 mm.; a= 61-86; b= 12-13; c= 11-12;

Females (2): L= 3.8-4.5 mm.; a= 65-66; b= 12-13; c= 10; V= 40-42.

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*gigas emended.

Spear= 5-6 μ; spear extensions= 8-10 μ; ventromedian supplements= 1-5; spicules 48-49 μ.

Oxydirus gigas (after Siddiqi, 1966):

Male (1): L= 3.7 mm.; a= 88; b= 13; c= 14; T= 53.

Spear= 6 μ; spear extensions= 11 μ; ventromedian supplements= 15; spicules 49 μ.

Habitat: Soil around roots of Crotalaria juncea from Jogipura, district Bijnor, U.P.

Differential diagnosis: Besides the differences in various body dimensions O. gigas differs from O. magnus in the shape of lip region and amphids, in having smaller and differently shaped spear, vagina without cuticularized pieces (vagina with cuticularized pieces in O. magnus) and differently shaped spicules.

FAMILY DORYLAIMELLIDAE (Jairajpuri, 1964) Thorne, 1964

GENUS *DORYLAIMELLUS* Cobb, 1913

Dorylaimellus parvulus Thorne, 1939

Habitats: i) Several females from *Gossypium arboreum* from Meerut district, U.P.

ii) Five females from *Crotalaria juncea* from Jalaun and Jhansi districts of U.P.

Dorylaimellus projectus Heyns, 1962

Habitat: Four females were collected from soil around roots of *Crotalaria juncea* from Handia, district Allahabad, U.P.

Dorylaimellus directus Heyns, 1963

Habitat: Twenty eight females from *Gossypium herbaceum* from Bulandshahr, Kanpur, Muzaffàrnagar and Saharanpur districts of U.P.

Dorylaimellus vexator Heyns, 1963

Habitat: Soil around roots of *Hibiscus cannabinus* from Ajanta, Maharashtra.

Dorylaimellus longicaudatus Jairajpuri, 1964

Dimensions:

Females (8): L= 0.82-0.96 mm.; a= 38-46; b= 4.5-5.0; c= 18-20; V= $\frac{4-6}{45-48}$ $\frac{6-7}{}$.

Description: (The original description of this species by Jairajpuri (1964) is based on a single specimen, it is amplified in the following).

Female: Body tapering towards both extremities. Lateral hypodermal chords 1/5th-1/4th of body-width near middle. Lateral glandular organs conspicuous, 45-52 in number, 9-11 in esophageal region, variable in size and squarish in shape and irregular in arrangement. Head off set, about 1/3rd of body-width at base of esophagus. Inner cephalic papillae form a very small disc-like structure.

Spear 6-7 µ long, about the width of lip region; its aperture 2 µ. Spear extensions 12-13 µ long. Basal expanded portion of esophagus occupies 46-52% of total esophageal length. Cardia hemispheroid.

Vulva longitudinal. Gonads amphidelphic. Prerectum 104-134 µ or 10-12 anal body-widths long. Rectum 9-13 µ, about one anal body-width long. Tail long, cylindrical, with rounded terminus, 4-5 times the anal body-width.

Male: Not found.

Habitat: Soil around roots of Crotalaria juncea from Barwe Sagar, district Jhansi, U.P.

Additional localities: Several females from Bulandshahr, Etah, Etawah and Saharanpur districts of U.P.

Dorylaimellus discocephalus Siddiqi, 1964

(Plate: XXVII, Figs. A-C)

Dimensions: See Table IV.

Description: (Based on a large number of specimens from different populations).

Female: Body tapering gradually anterior to slender part of esophagus, upon death lies curved in posterior third of its length. Lateral hypodermal chords 1/4th-1/3rd of body-width near middle. Lateral glandular organs conspicuous, 61-75 in number, variable in size and irregular in arrangement. Head well offset, about 1/3rd of body-width at base of esophagus. Amphidial apertures occupies 4-5 μ, about 3/4th the corresponding body-width. Sensillar pouches 13-15 μ from amphidial slits.

Spear 5-6 μ long, its aperture about 1/4th of its length. Spear extensions 10-12 μ long. Basal expanded portion of esophagus occupies 48-54% of total esophageal length.

Vulva longitudinal. Vagina 10-12 μ or less than 1/2 the corresponding body-width. Gonads amphidelphic and reflexed.

TABLE IV

Dorylaimellus discocephalus

Population	No. of specimens	Length in mm.	a	b	c	V
MEHALWALA	5 (♀♀)	0.91-1.06	42-48	3.7-4.4	33-42	5-7 50-55 5-7
DEOBAND	4 (♀♀)	0.98-1.03	40-47	3.8-5.6	34-37	5-7 50-51 5-8
MODIPUR	5 (♀♀)	1.07-1.21	42-45	4.3-5.1	38-41	7-8 51-53 6-7
AHMADPUR BRAHMAN	4 (♀♀)	1.01-1.07	41-46	4.4-5.0	34-40	6-7 50-53 6-7
BADALPUR	4 (♀♀)	1.03-1.25	41-46	4.9-5.4	34-44	5-8 50-53 6-7
CHAPROLLA	2 (♀♀)	0.96-1.11	52-62	4.0-5.0	34-37	6-7 51-54 6-8
KAURPUR	5 (♀♀)	1.02-1.21	39-44	4.8-5.2	34-42	5-7 49-51 6-7
SHAMLI	5 (♀♀)	1.02-1.10	45-49	3.6-5.2	32-36	6-7 49-52 5-7
KUREDA	5 (♀♀)	1.01-1.21	43-51	4.0-5.1	34-40	6-7 50-51 6-7

Prerectum 52-74 μ, about 3-4 anal body-widths long. Rectum about one anal body-width long. Tail elongate, cylindrical with bluntly rounded terminus, 2-2½ anal body-widths long.

Habitat: All the populations from soil around roots of Gossypium herbaceum from the following localities of U.P.: Mehalwala, Meerut; Deoband, Saharanpur; Modipur, Saharanpur; Ahmadpur Brahman, Saharanpur; Badalpur, Bulandshahr; Chaprolla, Bulandshahr; Kaurpur, Mainpuri; Shamli, Muzaffarnagar and Kureda, Muzaffarnagar.

Additional localities: Several females were also collected from Aligarh, Badaun, Banaras, Bijnor, Etah, Etawah, Jalaun, Jhansi, Mirzapur, Meerut and Moradabad districts of U.P.

Dorylaimellus indicus Siddiqi, 1964

(Plate: XXVII, Figs. D-F)

syn. Dorylaimellus pruni Husain and Khan, 1967

Dimensions: See Table V.

Description: (Based on a large number of specimens from different populations).

Female: Body tapering gradually anterior to slender part of esophagus and upon death lies curved in the posterior half, often 'C' shaped. Lateral hypodermal chords about 1/3rd of body-width near middle. Lateral glandular organs

conspicuous,90-112 in number, variable in size and irregular in arrangement. Head offset by a deep constriction, about 1/3rd of body-width at base of esophagus. Amphidial apertures occupy about 2/3rd of corresponding body-width. Sensillar pouches 16-19 μ from amphidial slits.

Spear 6-7 μ long, its aperture about 1/3rd of spear length. Spear extensions 11-12 μ long. Basal expanded portion of esophagus occupies 38-42% of total esophageal length.

Vulva longitudinal. Vagina 12-14 μ, extending about 1/3rd to 1/2 the corresponding body-width. Gonads amphidelphic and reflexed. Prerectum 37-66 μ, about 2-4 anal body-widths long. Rectum 12-15 μ long, less than one anal body-width long. Tail cylindrical, elongate with bluntly rounded terminus, about 1½-2 anal body-widths long.

Discussion: Husain and Khan (1967) separated *D. pruni* from *D. indicus*, only on the basis of posterior position of vulva and the tail shape. The present study on the intraspecific variations of *D. indicus* reveals that these differences do not justify the validity of *D. pruni*. Hence, it is regarded a synonym of *D. indicus*.

Habitats: Soil around roots of *Gossypium herbaceum* and *Gossypium arboreum* from the following localities of U.P.: Kailashpur, Saharanpur; Modipur, Saharanpur; Badalpur, Bulandshahr; Chaprolla, Bulandshahr; Ajitganj, Mainpuri; Banrti

T A B L E V

Dorylaimellus indicus

Population	No. of specimens	Length in mm.	a	b	c	V
KAILASHPUR	5 (♀♀)	1.00-1.31	45-53	6.7-7.6	37-42	5-7 6-8 50-52
MODIPUR	4 (♀♀)	1.37-1.66	44-49	7.9-9.0	34-44	6-7 5-7 49-51
BADALPUR	4 (♀♀)	1.48-1.62	46-50	8.3-9.0	35-46	6-7 6-8 49-51
CHAPROLLA	5 (♀♀)	1.32-1.54	41-45	7.8-8.9	39-46	6-7 6-7 50-52
AJITGANJ	3 (♀♀)	1.01-1.13	43-47	6.8-7.2	38-40	5-6 6-7 50-51
BANRTI KHAIRA	5 (♀♀)	1.28-1.52	44-53	7.3-8.1	40-46	5-7 6-7 48-51
MALPURA	5 (♀♀)	1.38-1.68	41-47	8.3-9.0	39-48	6-7 6-8 48-55
KAISHUPUR	3 (♀♀)	1.26-1.44	47-53	8.0-9.3	42-44	6-8 6-9 51-53

Khaira, Muzaffarnagar; Malpura, Agra and Kaishupur, Etawah.

Additional localities: Several females were also collected from Allahabad, Aligarh, Bijnor, Etah, Ghazipur, Jalaun, Jhansi, Mathura, Meerut and Mirzapur districts of U.P.

Dorylaimellus parvus Jairajpuri, 1965

(Plate: XXVIII)

Dimensions:

Females (6): L= 0.66 mm. (0.64-0.70 mm.); a= 35 (28-37); b= 3.5 (3.4-3.6); c= 22 (20-25); V= 53 (51-55).
8 9 6-11 7-11

Description: (The present population is described briefly so as to amplify the description of the species provided by Jairajpuri, 1965).

Female: Body tapering gradually at both extremities. Lateral hypodermal chords 1/4th-1/3rd of body-width near middle. Lateral glandular organs 51-64 in number of which 10-12 are in the esophageal region, variable in size and irregular in arrangement. Head offset by a deep constriction, slightly wider than adjoining body and about 1/3rd of body-width at base of esophagus. Inner cephalic papillae form a small disc-like structure. Amphidial apertures about 3 μ from anterior end, occupy 4 μ or about 3/4th the corresponding body-width. Sensillar pouches 14-15 μ from amphidial slits.

Spear 4-5μ long, its aperture 2 μ. Spear extensions 10-11 μ long, distinctly flanged. Basal expanded portion of esophagus occupies 48-54% of total esophageal length. Cardia rounded.

Vulva longitudinal. Gonads amphidelphic. Prerectum 54-75 μ or 5-8 anal body-widths long. Rectum 9-13 μ or about one anal body-width long. Tail cylindroid with rounded terminus, 2½-3 anal body-widths long.

Habitat: Soil around roots of Crotalaria juncea from Andamans.

Dorylaimellus jacobi* n. sp.

(Plate: XXIX)

Dimensions:

i) Mehalwala population (Type population): Females (7): L= 0.95 (0.89-0.98 mm.); a= 39 (36-42); b= 6.4 (6.0-7.0); c= 33 (32-35); V= $\overset{15}{58}$ ($\overset{12-18}{54-61}$ $\overset{3}{}$).

Female (holotype): L= 0.96 mm.; a= 40; b= 6.3; c= 34; V= $\overset{16}{56}$ $\overset{3}{}$.

Male (1): L= 0.80 mm.; a= 42; b= 5.5; c= 32; T= 51.

ii) Chaprolla population: Female (1): L= 0.94 mm.; a= 36; b= 5.4; c= 29; V= $\overset{12}{55}$ $\overset{2}{}$.

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*Named after Mr. J.J.s'Jacob, Landbouwhogeschool, Wageningen, The Netherlands.

iii) Deoband population: Females (2): L= 0.94-1.01 mm.; a^{18-23}_{3}= 39-40; b= 5.6-6.0; c= 31; V= 55-58 .

Description:

Female: Body tapering gradually anterior to slender part of esophagus and upon death lies irregularly curved. Outer cuticle 3 μ at tail, marked with faint transverse striations. Inner cuticle also faintly striated. Lateral hypodermal chords 1/4th-1/3rd of body-width near middle. Lateral glandular organs conspicuous, 70-85 in number of which 7-9 in esophageal region, variable in size and irregular in arrangement. Head set off, about as wide as adjoining body and nearly 1/3rd of body-width at base of esophagus. Amphidial apertures about 3 μ from anterior end, occupy 4-5 μ or more than 1/2 the corresponding body-width. Sensillar pouches 15-16 μ from amphidial slits.

Spear thin, 4-5 μ long, its aperture about 1 μ. Spear extensions 9-10 μ long. Basal expanded portion of esophagus occupies 35-41% of total esophageal length, its width 1/3rd-1/2 of body-width at base of esophagus and 1/8th-1/6th of its own length. Opening of dorsal esophageal gland 90-99 μ or 60-67% of esophageal length from anterior end. Nerve ring 54-60 μ from anterior end. Cardia rounded.

Vulva longitudinal. Vagina 9-12 μ long, extending about 1/3rd-1/2 across the body. Gonad mono-prodelphic. Posterior uterine sac 25-31 μ or 1 to 1½ body-width long.

Oviduct and uterus distinctly separated by sphincter, their combined length 112-178 μ. Uterus and posterior uterine sac filled with sperms. Prerectum 115 to 143 μ or 7-9 anal body-widths long. Tail cylindrical with bluntly rounded terminus, about 2 anal body-widths long.

Male: Supplements an adanal pair and 3 ventromedians, the latter begin about 2 anal body-widths above the anus, spaced nearly at regular intervals. Spicules 22 μ long medially. Lateral guiding pieces present, faintly visible and difficult to measure. Tail as in females, only slightly irregular in outline.

Habitat: Mehalwala population (Type): Soil around roots of Gossypium herbaceum from Mehalwala, district Meerut, U.P.

Chaprolla population: Soil around roots of Crotalaria juncea from Chaprolla, district Bulandshahr, U.P.

Deoband population: Soil around roots of Gossypium herbaceum from Deoband, district Saharanpur, U.P.

Type specimens: Collected in October, 1966; holotype mounted on slide MSJ/Dorylaimellus jacobi/1; paratypes on slides MSJ/Dorylaimellus jacobi/2-5. Specimens from Chaprolla and Deoband are mounted on slides MSJ/Dorylaimellus jacobi/6-8.

Differential diagnosis: Dorylaimellus jacobi n. sp., in having mono-prodelphic gonad comes close to D. aequalis

(Cobb, 1918) Thorne, 1939 but differs in having narrow amphids, more prominent and larger number of glandular organs, thin spear and smaller spear extensions, smaller posterior uterine sac, longer prerectum, differently shaped tail and spicules.

Dorylaimellus deviatus n. sp.

(Plate: XXX)

Dimensions:

Females (9): L= 0.46 mm. (0.40-0.48 mm.); a= 30 (27-31); b= 2.8 (2.4-3.0); c= 28 (27-30); $V = \frac{59}{5}\ (\frac{58\text{-}61}{4\text{-}6})$.

Female (holotype): L= 0.48 mm.; a= 30; b= 3.0; c= 30; $V = \frac{61}{5}$.

Description:

Female: Body tapering gradually anterior to slender part of esophagus and upon death lies straight or slightly curved in posterior third of its length. Outer cuticle 3-5 μ at tail, marked with faint transverse striations. Inner cuticle also faintly striated. Lateral hypodermal chords 1/4th-1/3rd of body-width near middle. Lateral glandular organs conspicuous, 32-40 in number of which 10-12 in esophageal region, variable in size and irregular in arrangement. Head set off, wider than adjoining body and about 1/3rd of body-width at base of esophagus. Inner labial papillae forming a disc-like structure. Amphidial apertures about 3 μ from anterior end and occupy 3-4 μ or

more than 1/2 of corresponding body-width. Sensillar pouches 8-9 μ from amphidial slits.

Spear 4-5 μ long, its aperture about 1 μ. Guiding ring about 4 μ from anterior end. Spear extensions 9-10 μ long. Basal expanded portion of esophagus occupies 50-55% of total esophageal length, its width nearly 1/2 of body-width at base of esophagus and 1/16th-1/13th of its own length. Opening of dorsal esophageal gland 91-98 μ or 54-57% of the esophageal length from anterior end. Nerve ring 48-55 u from anterior end. Cardia rounded.

Vulva longitudinal. Vagina 5-6 μ, extending about 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 19-28 μ of anterior gonad and 20-26 μ of posterior gonad. No sperms in uteri. Prerectum 34-47 μ or 3-4 anal body-widths long. Rectum 9-12 μ, about one anal body-width long. Tail almost rounded with slightly clavate terminus, about 1½ anal body-widths long.

Male: Not found.

Habitat: Soil around roots of Gossypium arboreum from Mundia Khurd, district Rampur, U.P.

Type specimens: Collected in November, 1966; holotype mounted on slide MSJ/Dorylaimellus deviatus/1; paratypes on slides MSJ/Dorylaimellus deviatus/2-4.

Differential diagnosis: Dorylaimellus deviatus n. sp., comes close to D. parvulus Thorne, 1939 and D. yangambiensis

Geraert, 1962. From the former it differs in having much wider lateral chords, larger number of glandular organs, differently shaped lip region, longer spear extensions and shorter prerectum. From D. yangambiensis it differs in having narrower amphids, rounded lip region with a labial disc, shorter spear and spear extensions and differently shaped tail.

KEY TO SPECIES OF DORYLAIMELLUS

1. Ovary one.....2
   Ovaries two.....5
2. Ovary opisthodelphic.....3
   Ovary prodelphic.....4
3. Vulva pre-equatorial (V= 38).....heynsi Andrássy, 1968
   Vulva post-equatorial (V= 54).....porosus Thorne, 1939
4. Post-uterine sac about 4 body-widths long.....
   .....aequalis (Cobb, 1918) Thorne, 1939
   Post-uterine sac about 1.5 body-widths.....jacobi n. sp.
5. Tail more than 4 anal body-widths long.....6
   Tail less than 3 anal body-widths long.....17
6. Tail long, filiform or ventrally arcuate.....7
   Tail cylindrical or subcylindrical with bluntly rounded terminus.....16
7. Tail with clavate tip.....8
   Tail with acute or subacute tip.....10
8. Body length more than 1 mm....paraclavatus Siddiqi, 1968
   Body length 0.7 mm. or less.....9

9. Spear 4-5 μ long; c= 12.....clavatus Thorne, 1964
   Spear 7 μ long; c= 7.....nygellurus Loof, 1964
10. Tail 8 or more anal body-widths long.....11
    Tail 6 or less anal body-widths long.....13
11. Esophagus long (b= 3-3.4); c= 5.....
    .....filicaudatus Thorne, 1964
    Esophagus short (b= more than 5.8); c= more than 8...
   12
12. Labial disc present.....salvus Siddiqi, 1968
    Labial disc absent.....filiformis Jairajpuri, 1964
13. Spear extensions about 4 times the spear length.....
    .....basiri Jairajpuri, 1965
    Spear extensions 3 times or less of spear length...14
14. Labial disc present.....salimi Siddiqi, 1966
    Labial disc absent.....15
15. Spear lumen easily visible, spear longer than head-
    width; V= 51-56.....spicatus Loof, 1964
    Spear lumen not easily visible, spear shorter than
    head-width; V= 43.....dorylaimoidurus Siddiqi, 1966
16. Cuticle coarsely striated; prerectum 10-12 anal body-
    widths long.....longicaudatus Jairajpuri, 1964
    Cuticle smooth; prerectum 3-4 anal body-widths long..
    .....paralongicaudatus Husain and Khan, 1967
17. Cuticle with prominent coarse striations, more than
    1 μ apart in the middle.....
    .....striatus Cobb in Thorne, 1939
    Cuticle finely striated or smooth.....18

18. Esophagus not narrowing while passing through nerve ring.....*nodochordus* Cobb in Thorne, 1939
Esophagus narrowing while passing through nerve ring 19

19. Tail distinctly ventrally arcuate.....20
Tail not ventrally arcuate.....21

20. Spear less than one head-width, aperture 1/3rd of its length.....*andrassyi* Heyns, 1963
Spear one head-width long, aperture 1/2 of its length.....*graminis* Kruger, 1965

21. Esophagus short, b= more than 6.1.....22
Esophagus long, b= less than 5.6.....25

22. Body length 0.67 mm.....*digitatus* Siddiqi, 1964
Body length 1.0 mm. or more.....23

23. Tail cylindrical and terminates with a rounded terminal cone.....*bambesae* de Coninck,1962
Tail terminus obtusely rounded.....24

24. Spear extensions 1.5 times spear length; small sclerotized bodies present in the vaginal wall..... .....*imitator* Heyns, 1963
Spear extensions 2 times spear length; sclerotized bodies not present in vaginal wall..... .....*indicus* Siddiqi, 1964

25. Tail hemispherical.....26
Tail subdigitate, bluntly-conoid, convex-conoid or elongate-conoid.....33

26. Body length more than 0.73 mm.....27
Body length less than 0.58 mm.....29

27. Labial disc absent.....longicollis Loof, 1964
Labial disc present.....28

28. Tail about 3 anal body-widths long, subclavate.....
.....belondirelloides Siddiqi, 1968
Tail about 2 anal body-widths long, not subclavate..
.....projectus Heyns, 1962

29. Lips angular, labial disc absent.....
.....yangambiensis Geraert, 1962
Lips amalgamated, labial disc present.....30

30. Lateral glandular organs 32-40.....deviatus n. sp.
Lateral glandular organs 15 or less.....31

31. Lateral glandular organs only in the esophageal region.....cataracticus Andrássy, 1968
Lateral glandular organs throughout the entire body length.....32

32. Prerectum 5 anal body-widths long; lateral glandular organs 15.....parvulus Thorne, 1939
Prerectum 2 anal body-widths long; lateral glandular organs 11.....caffrae Kruger, 1965

33. Tail subdigitate.....34
Tail bluntly-conoid, convex-conoid or elongate-conoid.....35

34. Body length about 1.4 mm.....virginianus Cobb, 1913
Body length about 0.8 mm.....demani Goodey, 1963

35. Spear about 3/4th head-width long.....36
Spear about one head-width or more.....40

36. Lip region continuous with body.....
.....*capitatus* Siddiqi, 1964
Lip region set off.....37
37. Body length 0.64-0.70 mm.; c= 20-25.....
.....*parvus* Jairajpuri, 1965
Body length more than 0.8 mm.; c= more than 27....38
38. Tail tip narrowly rounded.....*labiatus* Thorne, 1964
Tail tip broadly rounded.....39
39. Glandular organs 40; b= 2.9-3.6..*vexator* Heyns, 1963
Glandular organs 61-75; b= 3.6-5.6.....
.....*discocephalus* Siddiqi, 1964
40. Tail bluntly rounded, about 1.5 anal body-widths long.....41
Tail elongate-conoid, 2 or more anal body-widths long.....43
41. Body length 0.6 mm.....*tenuidens* Thorne, 1939
Body length more than 0.9 mm.....42
42. Prerectum about 5 anal body-widths long.....
.....*occidentalis* Thorne, 1939
Prerectum about 2 anal body-widths long.....
.....*rosae* Husain and Khan, 1967
43. Labial disc present..*processus* Husain and Khan, 1967
Labial disc absent.....44
44. Basal expanded portion of esophagus about 1/2 of esophageal length.....*montenegricus* Andrássy, 1959
Basal expanded portion of esophagus about 2/3rd of its length..... 45

45. Spear and its extensions 20-22 μ.....
.....directus Heyns, 1963
Spear and its extensions about 17 μ.....
.....monticolus Clark, 1963

Not included in the key:

Dorylaimellus mirus (Kirjanova, 1951) Andrássy, 1967 because of its inadequate description.

SUPERFAMILY DIPHTHEROPHOROIDEA (Micoletzky, 1922) Clark, 1961

FAMILY TRICHODORIDAE (Thorne, 1935) Clark, 1961

GENUS TRICHODORUS Cobb, 1913

Trichodorus mirzai Siddiqi, 1960

Habitats: i) Several females and males from Gossypium herbaceum from Bulandshahr, Meerut, Muzaffarnagar and Saharanpur districts, U.P.

ii) Eight females and 2 males from Gossypium arboreum from Kanpur district, U.P.

iii) Sixteen females and seven males from Hibiscus cannabinus from Jalaun and Jhansi districts, U.P.

SUPERFAMILY ALAIMOIDEA (Micoletzky, 1922) Goodey, 1963

FAMILY ALAIMIDAE Micoletzky, 1922

GENUS AMPHIDELUS Thorne, 1939

Amphidelus dudichi Andrássy, 1957

This species is here recorded for the first time from India.

Habitat: Twelve females from soil around roots of Gossypium herbaceum from Bulandshahr and Meerut districts of U.P.

Amphidelus novus n. sp.

(Plate: XXII, Figs. A-G)

Dimensions:

Females (2): L= 1.52-1.62 mm.; a= 66-68; b= 5.7-5.9; c= 6-9; $V = \frac{4\text{-}5}{32\text{-}33}$ $\frac{7\text{-}8}{}$.

Female (holotype): L= 1.73 mm.; a= 59; b= 6.1; c= 8; $V = \frac{5}{32}\ \frac{6}{}$.

Males (2): L= 1.45-1.66 mm.; a= 58-69; b= 5.5-5.6; c= 8-9; T= 53.

Description:

Female: Body tapering gradually anterior to slender part of esophagus. Cuticle smooth, its thickness varies

between 1-2 μ at various places in the body. Subcuticle with faint striations, less than 1 μ thick. Lip region narrow, slightly marked off from body; lips amalgamated. Width of lip region about 1/5th of body-width at base of esophagus. Lateral chords 1/7th-1/6th of body-width near middle. Amphids narrow, elongate; apertures 10-11 μ or two head-width from anterior end and occupy 3-4 μ. Sensillar pouches not seen.

Basal esophageal bulb occupies 12-17% of the total esophageal length, its width about 1/2 of body-width at base of esophagus and about 1/4th of its own length. Opening of dorsal esophageal gland 236-244 μ or 90-91% of the esophageal length from anterior end. The first pair of subventral esophageal glands open 10-14 μ from the dorsal esophageal gland opening. Nerve ring 102-107 μ from anterior end. Cardia very small, discoid.

Vulva a transverse slit. Vagina 9 μ, 1/3rd across the body. Gonads amphidelphic. Combined length of oviduct and uterus 71-92 μ and 100-143 μ of the anterior and posterior gonads respectively. Ovaries with a single flexure; oocytes arranged in a single row except at tip. Prerectum 51-68 μ or about 4 anal body-widths long. Rectum 13-16 μ or about one anal body-width long. Tail long, filiform, 183-241 μ or 11-18 times the anal body-width. Tail terminus finely rounded. Caudal pores not visible.

Male: Five ventromedian supplements arranged at irregular intervals. The first pair 10 μ above the anus, the second pair a little above the range of spicules. Spicules almost straight, 16 μ medially. Tail spirally curved, shape as in female, 11 times the anal body-width.

Habitat: Soil around roots of Gossypium arboreum from Pipalya Rayazada, district Rampur, U.P.

Type specimens: Collected in November, 1966; holotype and one paratype male mounted on slide MSJ/Amphidelus novus/1; 2 female paratypes and one male paratype on slides MSJ/ Amphidelus novus/2-3.

Differential diagnosis: Amphidelus novus n. sp., comes close to A. lemani (Stefanski, 1941) Thorne, 1939 but differs in the shape and location of amphids; position of vulva (V= 50 in A. lemani); in having straight spicules and 5 supplements in male (spicules sigmoid and only 3 supplements in A. lemani).

SUPERFAMILY MONONCHOIDEA (Chitwood, 1937) Clark, 1961

FAMILY BATHYODONTIDAE Clark, 1961

GENUS OIONCHUS Cobb, 1913

Oionchus obtusus Cobb, 1913

Habitat: Two females from Gossypium herbaceum from Pahasu, district Bulandshahr, U.P.

GEOGRAPHICAL DISTRIBUTION OF NEMATODES OF FIBROUS CROPS IN UTTAR PRADESH

Our knowledge of the nematodes associated with fibrous crops in India is very meagre. In the past, systematic survey so as to obtain a complete record of plant and soil nematodes has never been done. During the present survey, which was conducted in the years 1966-68, over 400 soil samples were collected from 91 different localities from 23 districts of Uttar Pradesh. These samples upon analysis yielded 54 genera belonging to 24 families and 10 super-families of the Order Tylenchida and Dorylaimida. In all, 93 species were identified under 39 genera, whereas a few species belonging to 15 genera remain unidentified.

The following is the list of genera arranged according to their systematic positions.

ORDER TYLENCHIDA THORNE, 1949

SUPERFAMILY TYLENCHOIDEA (Orley, 1880) Chitwood and Chitwood, 1937

FAMILY TYLENCHIDAE Orley, 1880

1. Tylenchus Bastian, 1865
2. Ditylenchus Filipjev, 1936
3. Pseudhalenchus Tarjan, 1958
4. Psilenchus de Man, 1921

5. Basiria Siddiqi, 1959
6. Clavilenchus (Jairajpuri, 1966) Thorne and Malek, 1968
7. Tylenchorhynchus Cobb, 1913
8. Telotylenchus Siddiqi, 1960

FAMILY HOPLOLAIMIDAE (Filipjev, 1934) Wieser, 1953

9. Hoplolaimus Daday, 1905
10. Helicotylenchus Steiner, 1945
11. Rotylenchus Filipjev, 1936
12. Pratylenchus Filipjev, 1936
13. Hirschmanniella Luc and Goodey, 1963
14. Rotylenchulus Linford and Oliveira, 1940

FAMILY HETERODERIDAE (Filipjev and Schuurmans Stekhoven, 1941) Skarbilovich, 1947

15. Meloidogyne Goeldi, 1887

FAMILY NEOTYLENCHIDAE (Thorne, 1941) Thorne, 1949

16. Dorsella Jairajpuri, 1966

SUPERFAMILY CRICONEMATOIDEA (Taylor, 1936) Geraert, 1966

FAMILY CRICONEMATIDAE (Taylor, 1936) Thorne, 1949

17. Hemicriconemoides Chitwood and Birchfield, 1957

FAMILY HEMICYCLIOPHORIDAE (Skarbilovich, 1959) Geraert, 1966

18. Hemicycliophora de Man, 1921

FAMILY PARATYLENCHIDAE (Thorne, 1949) Raski, 1962

19. Paratylenchus Micoletzky, 1922

SUPERFAMILY APHELENCHOIDEA (Fuchs, 1937) Thorne, 1949

FAMILY APHELENCHIDAE (Fuchs, 1937) Steiner, 1949

20. Aphelenchus Bastian, 1865

FAMILY APHELENCHOIDIDAE (Skarbilovich, 1947) Paramonov, 1953

21. Aphelenchoides Fischer, 1894

ORDER DORYLAIMIDA (DE MAN, 1876) PEARSE, 1942

SUPERFAMILY DORYLAIMOIDEA (de Man, 1876) Thorne, 1934

FAMILY DORYLAIMDAE de Man, 1876

22. Dorylaimus Dujardin, 1845
23. Eudorylaimus Andrássy, 1959
24. Mesodorylaimus Andrássy, 1959
25. Labronema Thorne, 1939
26. Thornenema Andrássy, 1959
27. Pungentus Thorne and Swanger, 1936

28. Discolaimus Cobb, 1913
29. Discolaimium Thorne, 1939

FAMILY APORCELAIMIDAE Heyns, 1965

30. Aporcelaimus Thorne and Swanger, 1936
31. Aporcelaimellus Heyns, 1965
32. Sectonema Thorne, 1930

FAMILY LONGIDORIDAE (Thorne, 1935) Meyl, 1961

33. Longidorus (Micoletzky, 1922) Filipjev, 1934
34. Xiphinema Cobb, 1913
35. Paralongidorus Siddiqi et al., 1963

FAMILY LEPTONCHIDAE Thorne, 1935

36. Leptonchus Cobb, 1920
37. Proleptonchus Lordello, 1955
38. Dorylaimoides Thorne and Swanger, 1936
39. Morasia n. gen.
40. Tylencholaimellus N.A. Cobb in M.V. Cobb, 1915
41. Tylencholaimus de Man, 1876
42. Tyleptus Thorne, 1939

FAMILY BELONENCHIDAE Thorne, 1964

43. Basirotyleptus Jairajpuri, 1964

SUPERFAMILY NYGOLAIMOIDEA (Thorne, 1935) de Coninck,1965

FAMILY NYGOLAIMIDAE (Thorne, 1935) Meyl, 1960

44. Nygolaimus Cobb, 1913

SUPERFAMILY ACTINOLAIMOIDEA (Thorne, 1939) Thorne, 1968

FAMILY ACTINOLAIMIDAE (Thorne, 1939) Meyl, 1961

45. Actinolaimus Cobb, 1913

SUPERFAMILY BELONDIROIDEA (Thorne, 1939) Thorne, 1964

FAMILY BELONDIRIDAE Thorne, 1939

46. Belondira Thorne, 1939

FAMILY OXYDIRIDAE Thorne, 1964

47. Oxydirus Thorne, 1939

FAMILY DORYLAIMELLIDAE (Jairajpuri, 1964) Thorne, 1964

48. Dorylaimellus Cobb, 1913

SUPERFAMILY DIPHTHEROPHOROIDEA (Micoletzky, 1922) Clark,1961

FAMILY DIPHTHEROPHORIDAE (Micoletzky, 1922) Thorne, 1935

49. Diphtherphora de Man, 1880

FAMILY TRICHODORIDAE (Thorne, 1935) Clark, 1961

50. Trichodorus Cobb, 1913

SUPERFAMILY ALAIMOIDEA (Micoletzky, 1922) Goodey, 1963

FAMILY ALAIMIDAE Micoletzky, 1922

51. Amphidelus Thorne, 1939

SUPERFAMILY MONONCHOIDEA (Chitwood, 1937) Clark, 1961

FAMILY MONONCHIDAE Chitwood, 1937

52. Mylonchulus (Cobb, 1916) Pennak, 1953

53. Hadronchus Mulvey and Jensen, 1967

FAMILY BATHYODONTIDAE Clark, 1961

54. Oionchus Cobb,1913

In table VI, the alphabets under the columns of the host(s) and the number under district(s) refer to the following:

HOSTS: A- Gossypium hirsutum

B- Gossypium herbaceum

C- Gossypium arboreum

D- Crotalaria juncea

E- Hibiscus cannabinus

DISTRICTS

1. Agra
2. Aligarh
3. Allahabad
4. Badaun
5. Banaras
6. Bijnor
7. Bulandshahr
8. Etah
9. Etawah
10. Ghazipur
11. Jalaun
12. Jhansi
13. Kanpur
14. Mainpuri
15. Mathura
16. Meerut
17. Mirzapur
18. Moradabad
19. Muzaffarnagar
20. Rampur
21. Saharanpur
22. Shahjahanpur
23. Nainital

TABLE VI

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Tylenchus striatus	-	B	-	D	-	5,12
T. leptus	A	B	-	D	-	2,5,12,14
T. ritai	-	B	-	D	E	4,6-8,12,16-19,21
T. arcuatus	A	B	-	D	-	12,15,18-20
Ditylenchus nanus	A	B	-	D	-	2,4-8,14-16,18-20
D. mirus	A	B	-	-	E	2,9,11,12,16,17,21
D. microdens	-	-	-	D	-	5
Pseudhalenchus anchilisposomus	-	-	-	D	-	12
Psilenchus minor	-	-	-	D	-	12
P. neoformis	-	B	-	-	-	19
Basiria graminophila	-	B	-	-	-	20
Clavilenchus tumidus	-	B	-	-	-	6
C. ritteri	-	B	-	D	-	1,21

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Tylenchorhynchus mashhoodi	-	B	-	D	E	1-3,5-10,13,16,17,19-22
T. martini	-	-	-	-	E	23
T. goffarti	-	-	-	-	E	5
T. capitatus	-	-	-	D	-	23
T. brevidens	-	B	-	-	-	16
T. divittatus	-	B	-	D	-	3,5,9,11-13,17
T. brassicae	-	B	C	D	-	2-4,7,9,12,14-16,19,21
T. mujtabai	-	B	-	-	-	9,14
Telotylenchus aerolatus	-	-	-	D	-	12
Hoplolaimus indicus	A	B	C	D	E	1-22
Helicotylenchus erythrinae	-	-	-	-	E	5,12
H. pseudorobustus	-	B	-	-	-	21
H. indicus	A	B	C	D	-	1,2-6,8-16,19-22
H. retusus	A	B	-	D	E	2,7,8,12,13,16,18,21
H. digitatus	-	B	C	-	-	7,16,19

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Helicotylenchus egyptiensis	-	-	C	D	-	6,12,17
Rotylenchus sp.	-	B	-	-	-	19
Pratylenchus thornei	A	B	C	D	E	2,3,5,7-9,11-22
Hirschmanniella oryzae	-	-	-	D	-	11,13
Rotylenchulus reniformis	-	B	-	-	-	16,19
Meloidogyne sp.	-	B	-	-	-	19
Dorsella indica	-	B	-	-	-	2
Hemicriconemoides sp.	-	B	-	-	-	16
Hemicycliophora eugeniae	-	B	-	-	-	16
Paratylenchus sp.	-	B	-	-	-	4
Aphelenchus avenae	A	B	C	D	E	1-22

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Aphelenchoides sp.	-	B	-	-	E	3,19
Dorylaimus spp.	A	B	-	D	-	1,4,7,10,13-16,21
Eudorylaimus spp.	A	B	C	D	E	1-23
Mesodorylaimus spp.	A	B	C	D	E	1-22
Labronema spp.	A	B	C	D	E	1-22
Thornenema mauritianum	A	B	C	D	-	2,4,6-9,15,16,18,22
Pungentus angulatus	A	-	-	-	-	2
Discolaimus major	-	B	-	D	-	3,7,17,19
D. similis	-	B	-	D	-	4,5,7,14,16,21
D. brevis	A	B	-	D	-	2,3,5,12,13,15,16,19,21
D. tenax	A	B	-	D	E	2,10,12,17,20

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Discolaimium bulbiferum	-	B	C	D	-	1,3-5,10-22
D. monhystera	-	-	-	D	-	17
D. simplex	-	-	-	D	-	17
D. brachyurum	-	-	-	-	E	17
D. arcuatum	-	-	-	D	-	5,12
D. mazhari	-	-	C	-	-	6
D. upum	A	B	-	-	-	2,8
D. mukhtarpuriensis	A	B	C	-	-	6,10,20
D. longicaudatum	-	B	-	-	-	19
Aporcelaimus spp.	-	B	-	D	-	3,5,7,16,19,21,23
Aporcelaimellus heynsi	-	B	C	-	-	2,6,7,14,16
A. indicus	A	-	-	-	-	14
A. hemicaudatus	-	B	-	D	-	1,10
A. raisi	-	B	-	-	-	14
Sectonema procta	-	B	-	-	-	18

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Longidorus sylphus	-	B	-	-	-	21
L. laevicapitatus	-	B	-	-	E	17,21
L. brevicaudatus	A	B	C	D	E	1-3,5-9,11,13-19,21
Xiphinema americanum	-	B	-	D	E	3,5,10,13,16,17,21
X. basiri	-	-	-	D	-	12
Paralongidorus citri	-	B	C	-	E	3,4,7,11,13,16,17,21
P. microlaimus	-	B	-	-	-	21
Leptonchus granulosus	-	B	-	D	-	6-9,16-19,21,22
L. capitatus	A	-	-	-	-	19
Proleptonchus aestivus	-	B	-	-	-	21
Dorylaimoides arcuatus	A	B	-	D	-	3,7,9,13,16,18,19
D. parateres	-	-	-	D	-	5
D. constrictus	-	-	-	D	-	5

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Dorylaimoides grandis	-	B	-	D	-	6,12
D. arcuicaudatus	-	-	-	-	E	12
Morasia dimorphicauda	-	B	C	-	-	13,19,21
Tylencholaimellus eskei	-	B	-	-	-	16,19
T. sayeedi	-	-	C	-	-	20
Tylencholaimus minimus	-	B	-	D	-	12,13,17,19
T. leptonchoides	-	B	-	-	-	7,9
T. obscurus	A	B	C	D	-	1,2,4,5,8,10,12,14,16,19,21
Tyleptus variabilis	-	-	C	-	-	4,18
Basirotyleptus basiri	-	B	-	D	-	12,13,16
Nygolaimus spp.	A	B	C	D	E	1-8,10-23
Actinolaimus spp.	A	B	-	-	-	2,6,13

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Belondira paraclava	-	B	-	D	-	5,9,11,12,17,19-21
Oxydirus magnus	-	-	-	D	-	5
O. gigas	-	-	-	D	-	6
Dorylaimellus parvulus	-	-	C	D	-	11,12,16
D. projectus	-	-	-	D	-	3
D. directus	-	B	-	-	-	7,13,19,21
D. longicaudatus	-	B	-	D	-	7-9,12,21
D. discocephalus	-	B	C	D	-	2,4-9,11,12,14,16-19,21
D. indicus	-	B	C	D	E	1-3,6-12,14-17,19,21
D. jacobi	-	B	-	D	-	7,16,21
D. deviatus	-	-	C	-	-	20
Diphtherophora sp.	A	B	-	-	-	7,20
Trichodorus mirzai	-	B	-	D	E	7,11-13,16,19,21

TABLE VI (Contd.)

NEMATODE SPECIES	HOST(S) PLANTS					DISTRICT(S)
Amphidelus dudichi	-	B	-	-	-	7,16
A. novus	-	-	C	-	-	20
Mylonchulus spp.	A	B	-	D	E	2,4,12,16,19,23
Hadronchus spp.	-	B	C	D	E	3-5,7,17,19,21
Oionchus obtusus	-	B	-	-	-	7

QUANTITATIVE STUDY OF NEMATODES OF COTTON IN UTTAR PRADESH

A preliminary study was made to find out the relative abundance and degree of dominance of different genera of nematodes associated with the following three species of cotton in Uttar Pradesh: Gossypium hirsutum, G. herbaceum and G. arboreum. For this study about 200 soil samples were collected from the following 15 major cotton growing districts: Agra, Allahabad, Badaun, Bijnor, Bulandshahr, Etah, Etawah, Kanpur, Mainpuri, Meerut, Mirzapur, Moradabad, Muzaffarnagar, Rampur and Saharanpur. The soil texture and pH were determined for each sample to find out the probable effect of these factors on nematode populations.

METHODOLOGY:

Sampling and Isolation: Sampling and isolation methods were same as described earlier under Material and Methods except that the bulk sample was thoroughly mixed with hand and only 100 ml. of soil was used for processing.

Counting: The entire suspension obtained after the extraction of the nematodes was transferred to a graduated flask and the nematodes were allowed to settle down at the bottom. The suspension was concentrated to 100 ml. by

pipetting out the extra volume of water. This suspension was made homogenous with the help of an aerator or a bubler and 10 ml. was taken out with the help of a pipette and transferred to a syracuse counting dish. The counting was repeated twice and mean values were determined.

Soil Texture and pH: The soil texture of the samples was determined by the Regional Research Soil Laboratory, Aligarh, U.P. The pH of soil was determined in the laboratory.

NEMATODE GROUPS:

The nematodes were grouped into the following three categories based on their feeding habits: Plant parasites, other Dorylaimida and saprophagus. The predatory nematodes of the superfamily Mononchoidea were counted along with other Dorylaimida.

1. Plant Parasites: The nematodes living on plant hosts as endo-or ectoparasites are included under this group. From the economic point of view it naturally becomes the most important group. The genera recorded belong to the following families: Tylenchidae, Hoplolaimidae, Heteroderidae, Aphelenchidae, Aphelenchoididae, Longidoridae and Trichodoridae. Some genera of these families are already confirmed plant parasites, while a few are suspected

plant parasites. All the genera of this group have been counted separately.

2. Other Dorylaimida: The nematodes belonging to this group include the genera of the families Dorylaimidae, Aporcelaimidae, Leptonchidae, Belonenchidae, Nygolaimidae, Actinolaimidae, Belondiridae, Oxydiridae, Dorylaimellidae, Diphtherophoridae and Mononchidae. These nematodes are suspected to feed on other micro-organisms. The nematodes belonging to the families Belondiridae, Leptonchidae, Belonenchidae and Diphtherophoridae have been suspected as plant parasites by Thorne (1964) and some other workers but this fact remains to be verified.

3. Saprophagus: The nematodes of the families Rhabditidae, Cephalobidae, Plectidae, Axonolaimidae and Ironidae come under this category. The nematodes are supposed to feed on decaying organic matter and also on bacteria associated with the decaying.

RESULTS:

1. AGRA

No. of samples: 12

Texture of soil: Loam and Clayey-loam

pH of soil: 7.0-8.2

Nematodes	per 100 ml. of soil
Tylenchus	50-80
Ditylenchus	10-40
Tylenchorhynchus	40-410
Hoplolaimus	10-70
Helicotylenchus	30-40
Aphelenchus	10-15
Other Dorylaimida	90-450
Saprophagus	170-310

2. ALLAHABAD

No. of samples: 14

Texture of soil: Sandy-loam and Loam

pH of soil: 7.0-7.5

Ditylenchus	40-50
Tylenchorhynchus	110-180
Hoplolaimus	20-100
Helicotylenchus	10-90
Pratylenchus	50-210
Aphelenchus	5-140
Other Dorylaimida	200-410
Saprophagus	80-280

3. BADAUN

No. of samples: 12

Texture of soil: Loam and Sandy-loam

pH of soil: 6.0-8.0

Nematodes	per 100 ml. of soil
Tylenchus	10-50
Ditylenchus	10-270
Tylenchorhynchus	30-520
Hoplolaimus	20-270
Helicotylenchus	10-60
Other Dorylaimida	28-520
Saprophagus	120-720

4. BIJNOR

No. of samples: 11

Texture of soil: Loam, Sanday-loam and Clayey loam

pH of soil: 7.0-8.5

Tylenchus	40-70
Ditylenchus	20-240
Tylenchorhynchus	150-1300
Hoplolaimus	40-230
Helicotylenchus	80-720
Aphelenchus	20-300
Other Dorylaimida	220-680
Saprophagus	230-600

5. BULANDSHAHR

No. of samples: 24

Texture of soil: Loam, Sandy-loam and Clayey-loam

pH of soil: 6.0-8.2

Nematodes	per 100 ml. of soil
Tylenchus	10-200
Ditylenchus	110-130
Tylenchorhynchus	90-570
Hoplolaimus	10-610
Helicotylenchus	30-100
Aphelenchus	30-110
Trichodorus	20
Other Dorylaimida	150-570
Saprophagus	70-1000

6. ETAH

No. of samples: 13

Texture of soil: Loam, Sandy-loam and Clayey-loam

pH of soil: 6.0-7.6

Ditylenchus	10-240
Tylenchorhynchus	10-160
Hoplolaimus	110-570
Helicotylenchus	10-230
Pratylenchus	10-20
Aphelenchus	10-20
Other Dorylaimida	30-630
Saprophagus	30-270

7. ETAWAH

No. of samples: 9

Texture of soil: Sandy-loam and Loam

pH of soil: 6.5-7.5

Nematodes	per 100 ml. of soil
Tylenchus	20-60
Ditylenchus	10-30
Tylenchorhynchus	110-250
Hoplolaimus	50-150
Aphelenchus	10-20
Paralongidorus	10
Other Dorylaimida	130-560
Saprophagus	40-180

8. KANPUR

No. of samples: 13

Texture of soil: Sandy-loam and Loam

pH of soil: 6.5-8.0

Tylenchus	10-60
Tylenchorhynchus	20-460
Hoplolaimus	30-300
Pratylenchus	20-150
Aphelenchus	20
Aphelenchoides	20
Longidorus	20-40
Paralongidorus	20
Other Dorylaimida	80-430
Saprophagus	80-200

9. MAINPURI

No. of samples: 8

Texture of soil: Loam and Sandy-loam

pH of soil: 6.0-7.6

Nematodes	per 100 ml. of soil
Tylenchus	10-20
Ditylenchus	20
Tylenchorhynchus	80-340
Hoplolaimus	20-350
Helicotylenchus	40-45
Pratylenchus	40
Aphelenchus	20-40
Other Dorylaimida	180-450
Saprophagus	40-890

10. MEERUT

No. of samples: 18

Texture of soil: Loam, Sandy-loam and Clayey-loam

pH of soil: 6.0-8.2

Tylenchus	10-20
Ditylenchus	20-110
Tylenchorhynchus	30-750
Hoplolaimus	10-100
Helicotylenchus	10-180
Pratylenchus	50-270
Aphelenchus	40-1140
Other Dorylaimida	100-490
Saprophagus	50-1000

11. MIRZAPUR

No. of sample: 1

Texture of soil: Sandy-loam

pH of soil: 6.5

Nematodes	per 100 ml. of soil
Tylenchorhynchus	30
Hoplolaimus	20
Aphelenchus	40
Other Dorylaimida	140
Saprophagus	180

12. MORADABAD

No. of samples: 7

Texture of soil: Loam and Sandy-loam

pH of soil: 6.0-8.2

Tylenchus	20-50
Ditylenchus	20
Tylenchorhynchus	30-360
Hoplolaimus	10-20
Helicotylenchus	20-60
Pratylenchus	40-70
Aphelenchus	10-30
Other Dorylaimida	120-440
Saprophagus	100-320

13. MUZAFFARNAGAR

No. of samples: 25

Texture of soil: Loam, Sandy-loam and Clayey-loam

pH of soil: 6.0-8.2

Nematodes	per 100 ml. of soil
Tylenchus	40-160
Ditylenchus	10-30
Tylenchorhynchus	20-900
Hoplolaimus	10-800
Helicotylenchus	30-800
Rotylenchus	10
Pratylenchus	10-30
Rotylenchulus	630-5200
Meloidogyne	20
Aphelenchus	10-60
Trichodorus	10-100
Other Dorylaimida	70-1260
Saprophagus	40-1100

14. RAMPUR

No. of samples: 10

Texture of soil: Sandy-loam and Clayey-loam

pH of soil: 6.0-8.2

Nematodes	per 100 ml. of soil
Ditylenchus	10-50
Tylenchorhynchus	30-480
Hoplolaimus	10-20
Helicotylenchus	20-730
Aphelenchus	10-260
Other Dorylaimida	180-290
Saprophagus	140-290

15. SAHARANPUR

No. of samples: 21

Texture of soil: Loam, Sandy-loam and Clayey-loam

pH of soil: 6.0-8.5

Tylenchus	20-250
Ditylenchus	40-150
Tylenchorhynchus	20-760
Hoplolaimus	10-200
Helicotylenchus	10-200
Pratylenchus	90-160
Aphelenchus	20-110
Longidorus	20-60
Paralongidorus	20-30
Other Dorylaimida	160-1240
Saprophagus	60-330

DISCUSSION:

Among the plant parasitic genera, species of Tylenchorhynchus were most abundant and present nearly in all the samples, generally dominating over other parasitic forms. Hoplolaimus indicus was present in small numbers in 95% samples but dominating only in 5% of them. The species of Helicotylenchus and Pratylenchus were found in 70% and 40% of the samples respectively and in 7% of the samples they were the dominating forms. Tylenchus and Ditylenchus were present in 60% and 50% of the samples respectively but in small numbers. The species, Aphelenchus avenae was quite numerous in 30% of the samples. Longidorus brevicaudatus was recovered from 15% and Paralongidorus citri from 5% of the samples. Trichodorus mirzai has also been found from 10% samples but only few specimens were recovered. The remaining genera of this group were found occasionally and in insignificant numbers. Rotylenchulus reniformis was found only in few samples but in two samples from Muzaffarnagar district its degree of dominance was exceptionally very high. The genera Tylenchorhynchus and Hoplolaimus are probably more specific to the cotton crop in Uttar Pradesh than other genera. The species Tylenchorhynchus mashhoodi, T. brassicae, T. divittatus and Hoplolaimus indicus were most abundant.

In the group 'Other Dorylaimida', the species of the genera Eudorylaimus, Mesodorylaimus, Labronema, Thornenema, and Dorylaimellus were most abundant in this region. The nematodes belonging to 'Saprophagus' group were found nearly in all the samples with the species of the genus Ironus Bastian, 1865 being the most common.

It was noted that loam and sandy-loam texture of the soil was most favourable for large nematode populations as compared to clayey-loam. The sandy-loam texture seems favourable for the genera Longidorus, Xiphinema and Paralongidorus. The presence of the genera Tylenchorhynchus, Hoplolaimus, Helicotylenchus, Pratylenchus, Aphelenchus, Eudorylaimus, Mesodorylaimus, Labronema, Thornenema and Dorylaimellus in most of the soil samples examined in this project is probably due to the fact that they are quite resistant to the changes in pH and also do not have any particular preference for the soil type. From the present study no definite conclusion could be drawn about the effects of the variations in the pH of the soil on nematode populations.

SUMMARY

In the present work, 100 species belonging to the Orders Tylenchida and Dorylaimida (Nematoda) have been reported from soil around the roots of fibrous crops from India. These species come under 24 families, 2 new genera and 53 known genera. Twenty four of these species are new to Science and 11 known species have been recorded for the first time from India. Males of 3 known species have been reported for the first time. Three new combinations under Dorylaimoidea have been proposed. Family Dorylaimellidae and some known species which were considered synonyms in the past have been re-validated.

I. CROPS SURVEYED:

1. Gossypium hirsutum L.
2. G. herbaceum L.
3. G. arboreum L.
4. Crotalaria juncea L.
5. Hibiscus cannabinus L.

II. THE FAMILIES:

1. Tylenchidae
2. Hoplolaimidae
3. Heterodéridae
4. Neotylenchidae
5. Criconematidae
6. Hemicycliophoridae

7. Paratylenchidae
8. Aphelenchidae
9. Aphelenchoididae
10. Dorylaimidae
11. Aporcelaimidae
12. Longidoridae
13. Leptonchidae
14. Belonenchidae
15. Nygolaimidae
16. Actinolaimidae
17. Belondiridae
18. Oxydiridae
19. Dorylaimellidae
20. Diphtherophoridae
21. Trichodoridae
22. Alaimidae
23. Mononchidae
24. Bathyodontidae

III. THE NEW GENERA:

1. Willinema
2. Morasia

IV. THE KNOWN GENERA:

1. Tylenchus
2. Ditylenchus
3. Pseudhalenchus
4. Psilenchus
5. Basiria
6. Clavilenchus
7. Tylenchorhynchus
8. Telotylenchus
9. Hoplolaimus
10. Helicotylenchus
11. Rotylenchus
12. Pratylenchus
13. Hirschmanniella
14. Rotylenchulus
15. Meloidogyne
16. Dorsella
17. Hemicriconemoides
18. Hemicycliophora
19. Paratylenchus
20. Aphelenchus

21. Aphelenchoides
22. Dorylaimus
23. Eudorylaimus
24. Mesodorylaimus
25. Labronema
26. Thornenema
27. Pungentus
28. Discolaimus
29. Discolaimium
30. Aporcelaimus
31. Aporcelaimellus
32. Sectonema
33. Longidorus
34. Xiphinema
35. Paralongidorus
36. Leptonchus
37. Proleptonchus
38. Dorylaimoides
39. Tylencholaimellus
40. Tylencholaimus
41. Tyleptus
42. Basirotyleptus
43. Nygolaimus
44. Actinolaimus
45. Belondira
46. Oxydirus
47. Dorylaimellus
48. Diphtherophora
49. Trichodorus
50. Amphidelus
51. Mylonchulus
52. Hadronchus
53. Oionchus

V. THE NEW SPECIES:

1. Clavilenchus ritteri
2. Tylenchorhynchus hexincisus
3. T. mujtabai
4. Telotylenchus historicus
5. T. aerolatus
6. Willinema indicum
7. Pungentus angulatus
8. Discolaimium mazhari
9. Discolaimium upum
10. D. mukhtarpuriensis
11. D. longicaudatum
12. Aporcelaimellus heynsi
13. A. indicus
14. A. hemicaudatus
15. A. raisi
16. Sectonema procta

17. Leptonchus capitatus
18. Dorylaimoides constrictus
19. D. grandis
20. D. arcuicaudatus
21. Morasia dimorphicauda
22. Dorylaimellus jacobi
23. D. deviatus
24. Amphidelus novus

VI. THE KNOWN SPECIES:

1. Tylenchus striatus
2. T. leptus
3. T. ritai
4. T. arcuatus
5. Ditylenchus nanus
6. D. mirus
7. D. microdens
8. Pseudhalenchus anchilisposomus
9. Psilenchus minor
10. P. neoformis
11. Basiria graminophila
12. Clavilenchus tumidus
13. Tylenchorhynchus mashhoodi
14. T. martini
15. T. goffarti
16. T. capitatus
17. T. brevidens
18. T. divittatus
19. T. brassicae
20. Hoplolaimus indicus
21. Helicotylenchus erythrinae
22. Helicotylenchus pseudorobustus
23. H. indicus
24. H. retusus
25. H. digitatus
26. H. egyptiensis
27. Pratylenchus thornei
28. Hirschmanniella oryzae
29. Rotylenchulus reniformis
30. Dorsella indica
31. Hemicycliophora eugeniae
32. Aphelenchus avenae
33. Thornenema mauritianum
34. T. baldum
35. Discolaimus major
36. D. similis
37. D. brevis
38. D. tenax
39. Discolaimium bulbiferum
40. D. monhystera
41. D. simplex
42. D. brachyurum

43. Discolaimium arcuatum
44. Longidorus sylphus
45. L. laevicapitatus
46. L. brevicaudatus
47. Xiphinema americanum
48. X. basiri
49. Paralongidorus citri
50. P. microlaimus
51. Leptonchus granulosus
52. Proleptonchus aestivus
53. Dorylaimoides arcuatus
54. D. parateres
55. Tylencholaimellus eskei
56. T. sayeedi
57. Tylencholaimus minimus
58. T. leptonchoides
59. T. obscurus
60. Tyleptus variabilis
61. Basirotyleptus basiri
62. Belondira paraclava
63. Oxydirus oxcycephalus
64. O. magnus
65. O. gigas
66. Dorylaimellus parvulus
67. D. projectus
68. D. directus
69. D. vexator
70. D. longicaudatus
71. D. discocephalus
72. D. indicus
73. D. parvus
74. Trichodorus mirzai
75. Amphidelus dudichi
76. Oionchus obtusus

VII. MALES RECORDED FOR THE FIRST TIME:

1. Thornenema baldum
2. Dorylaimoides arcuatus
3. D. parateres

VIII. THE NEW RECORDS FROM INDIA:

1. Ditylenchus microdens
2. Clavilenchus tumidus
3. Tylenchorhynchus goffarti
4. Helicotylenchus pseudo-robustus
5. H. egyptiensis
6. Longidorus sylphus

7. Longidorus laevicapitatus
8. Oxydirus oxycephalus
9. Oxydirus magnus
10. Dorylaimellus projectus
11. Amphidelus dudichi

IX. THE NEW COMBINATIONS:

1. Thornenema mauritianum (Williams, 1959)

   syn. Chrysonema mauritiana Williams, 1959

2. Willinema parvum (Williams, 1959)

   syn. Thornenema parvum (Williams, 1959) Williams, 1964

3. Morasia rhabdotus (Kreis, 1930)

   syn. Dorylaimoides rhabdotus (Kreis, 1930) Thorne and Swanger, 1936

X. THE SYNONYMS:

Psilenchus hilarus synonym of P. neoformis

Tylenchorhynchus dactylurus, T. digitatus, T. crassicaudatus, T. elegans and T. zeae synonyms of T. mashhoodi

Thornenema paradoxum synonym of T. baldum

Thornenema viriosum, T. filiforme, T. delhiensis and T. africanum synonyms of T. mauritianum

Dorylaimellus pruni synonym of D. indicus

Oxydirus magnus apud Siddiqi, 1966 synonym of O. gigas

XI. DIAGNOSIS EMENDED:

Thornenema

XII. SPECIES REDESCRIBED:

1. Tylenchorhynchus mashhoodi
2. T. martini
3. T. goffarti
4. Thornenema baldum
5. T. mauritianum
6. Discolaimium bulbiferum
7. Dorylaimoides arcuatus
8. D. parateres
9. Dorylaimellus longicaudatus
10. D. discocephalus
11. D. indicus
12. D. parvus

XIII. RE-VALIDATED:

1. Belondira paraclava which was considered a synonym of B. caudata by Siddiqi (1966)
2. Oxydirus gigas which was doubtfully synonymized with O. magnus by Siddiqi (1966)
3. Family Dorylaimellidae which was considered synonym of Belondiridae by Siddiqi (1968)

XIV. SPECIES INQUIRENDAE:

1. Pungentus ichthyuris
2. P. intertextus
3. P. minnsi
4. Pungentus stylidens
5. P. fuorni
6. Dorylaimellus mirus

XV. The qualitative and quantitative studies of the nematodes associated with fibrous crops in Uttar Pradesh revealed that the species of the genera Tylenchorhynchus, Hoplolaimus, Helicotylenchus, Tylenchus, Ditylenchus, Pratylenchus and Aphelenchus are widely distributed. The genera Eudorylaimus, Mesodorylaimus, Labronema, Thornenema, Discolaimium and Dorylaimellus are also of common occurrence.

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P L A T E I

Figs. A-G *Clavilenchus ritteri* n. sp.

A. Entire female

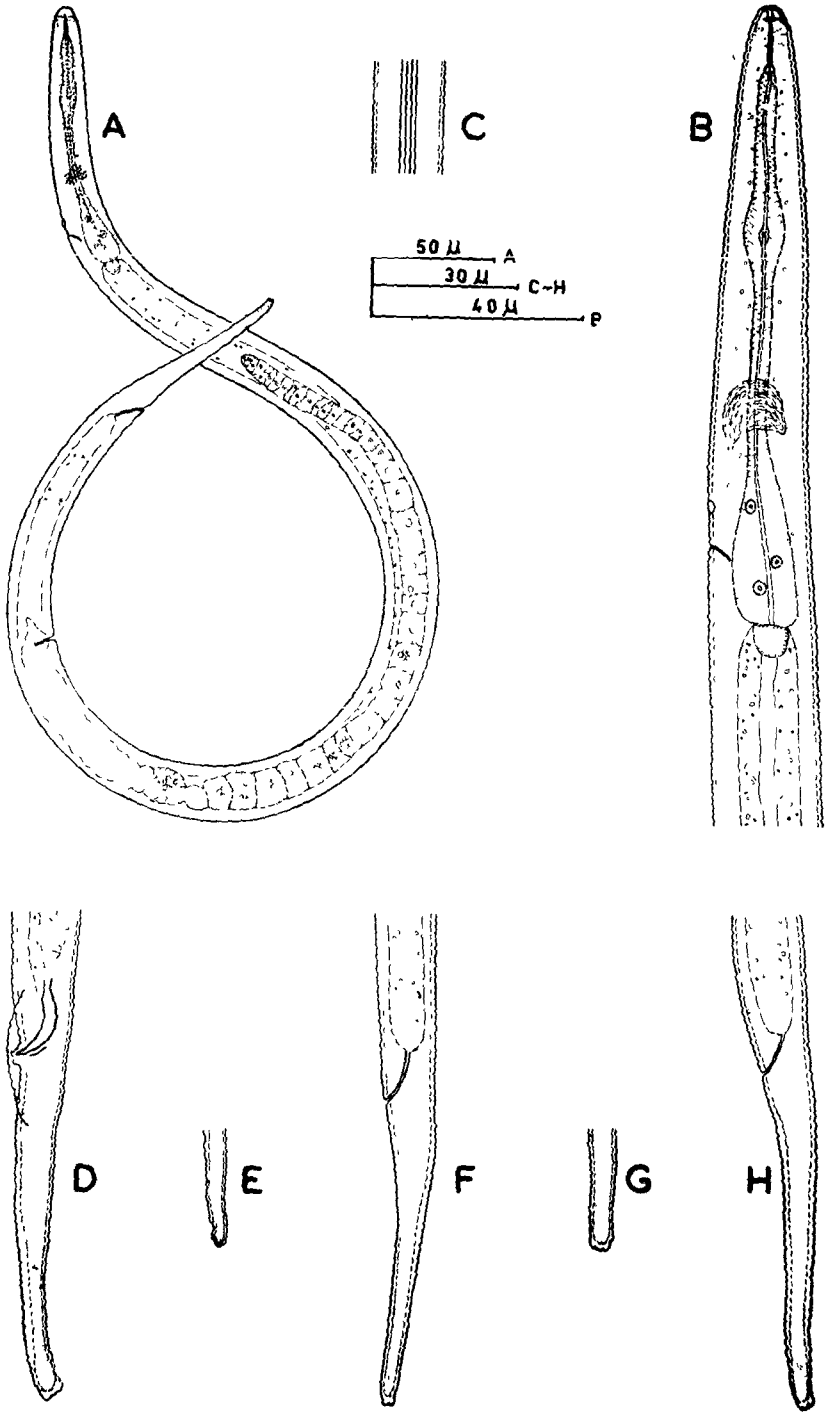
B. Esophageal region

C. Lateral fields

D. Tail end, male

F&H. Tail ends, female.

E&G. Tail tips, female


A
C
B
50 µ
A
30 µ
C-H
40 µ
P
D
E
F
G
H

P L A T E II

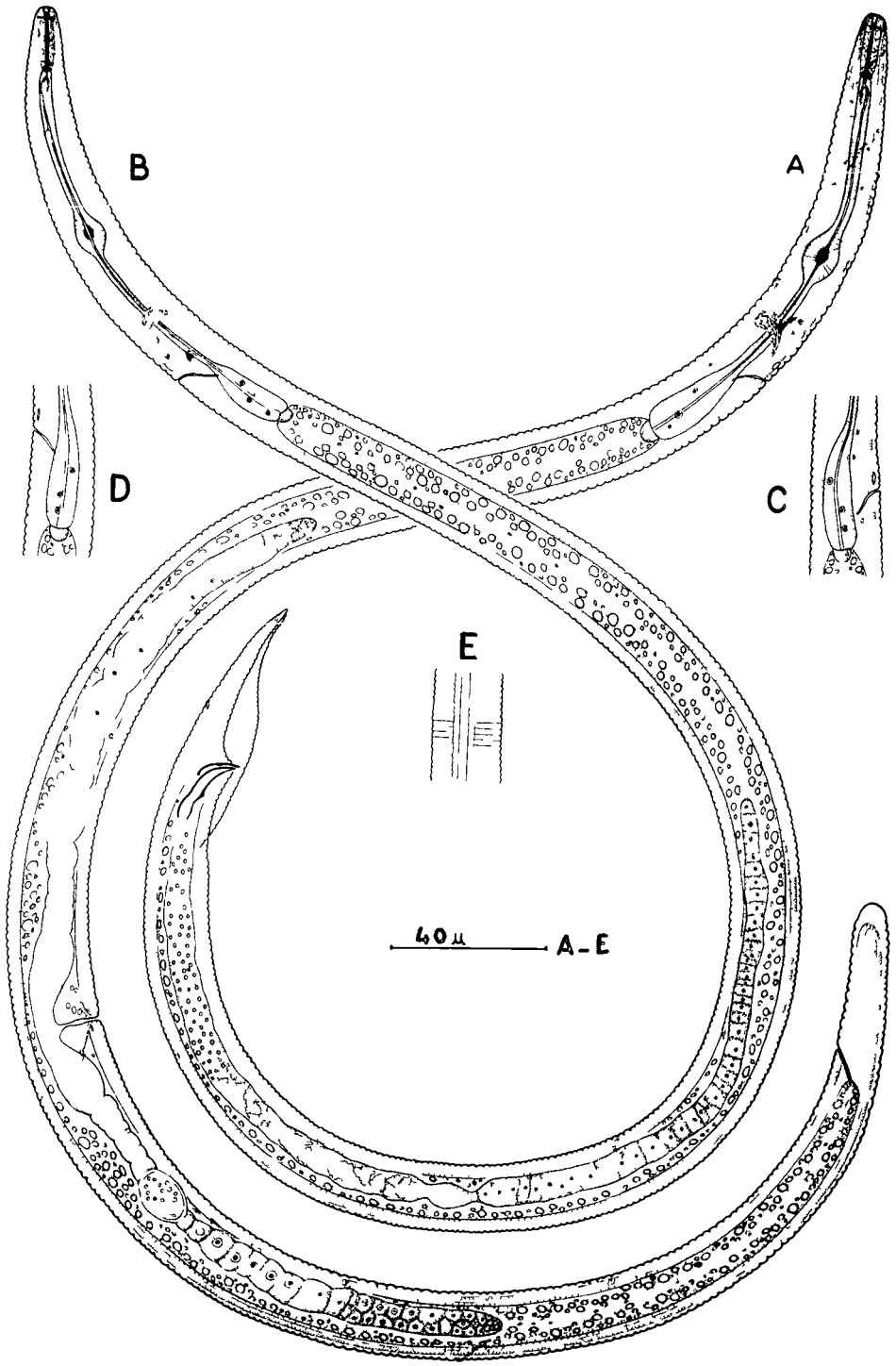
Figs. A-E *Tylenchorhynchus mashhoodi* Siddiqi & Basir, 1959

A. Entire female

B. Entire male

C&D. Esophageal gland lobes

E. Lateral fields near midbody


B
A
D
C
E
40 µ
A-E

P L A T E III

Figs. A-W *Tylenchorhynchus mashhoodi*

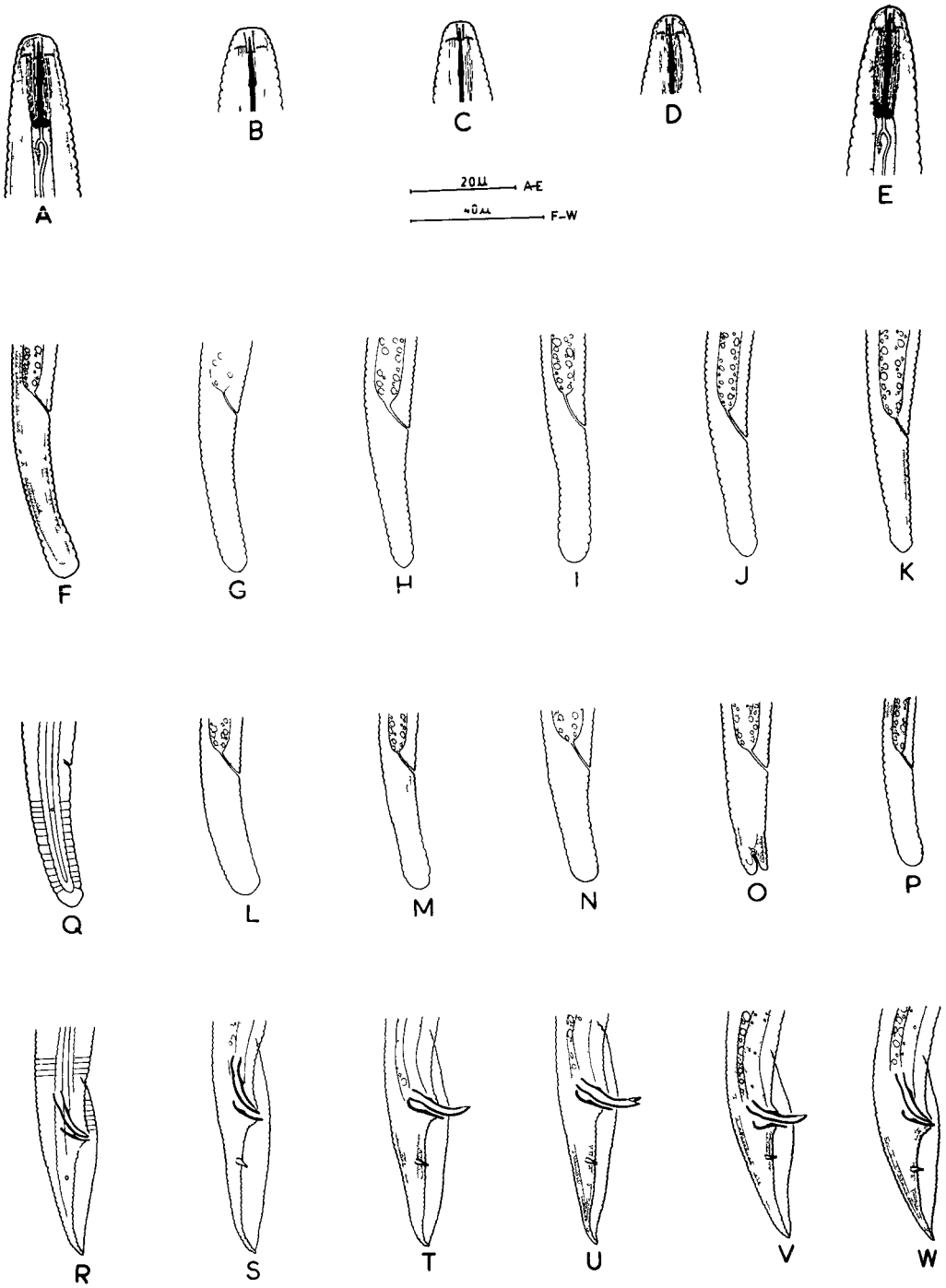
A-E. Head ends

F-P. Female tails

Q. Female tail, surface view

R. Male tail, surface view

S-W. Male tails


A
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V
W

P L A T E IV

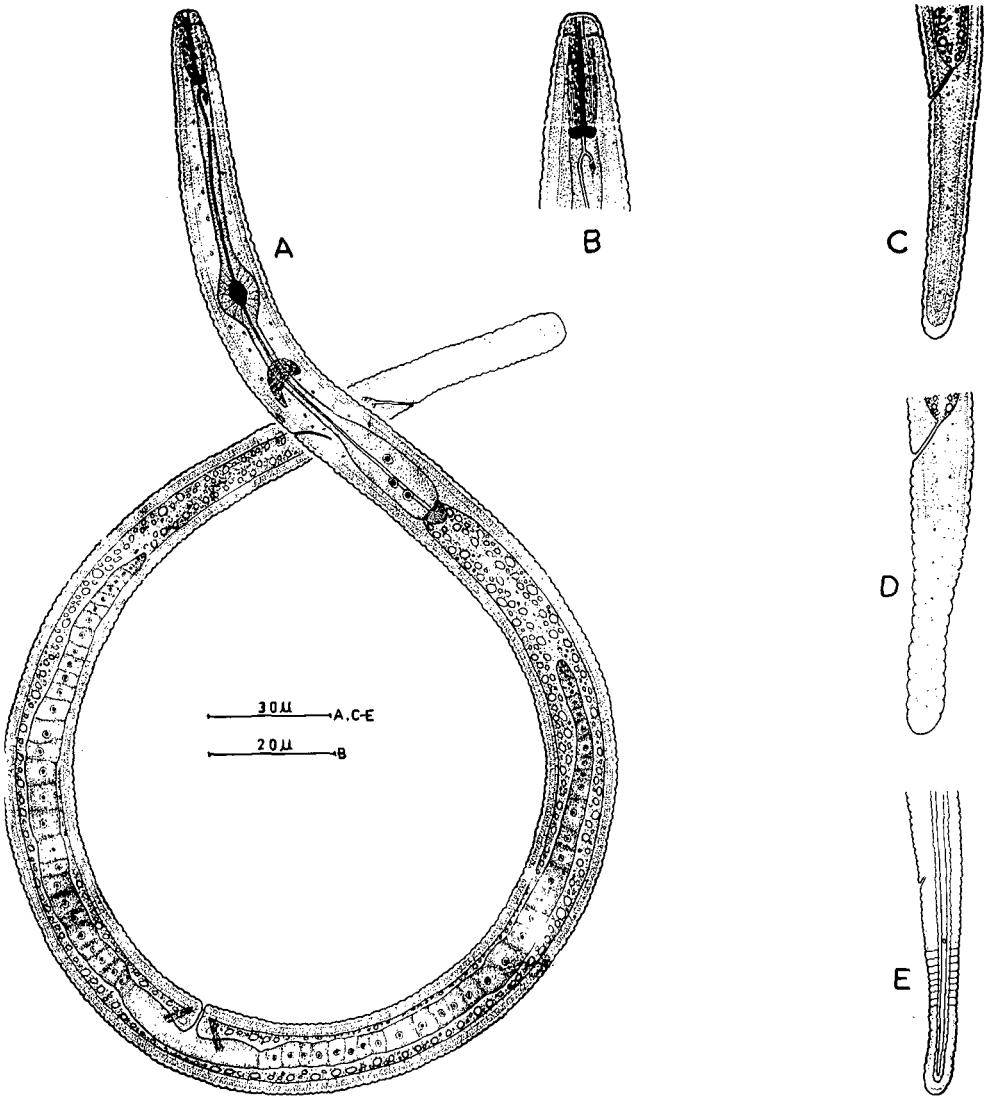
Figs. A-E *Tylenchorhynchus martini* Fielding, 1956

A. Entire female

B. Head end

C&D. Female tails

E. Female tail, surface view


A
B
C
D
E
30µ
A, C-E
20µ
B

P L A T E V

Figs. A-D *Tylenchorhynchus goffarti* Sturhan, 1966

A. Head end

B. Female tail

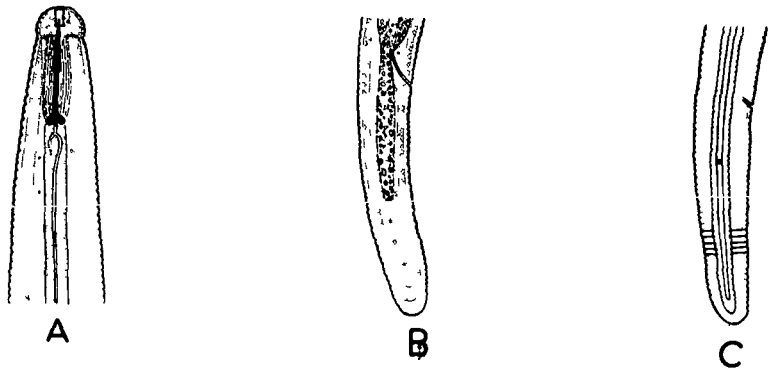
C. Female tail, surface view

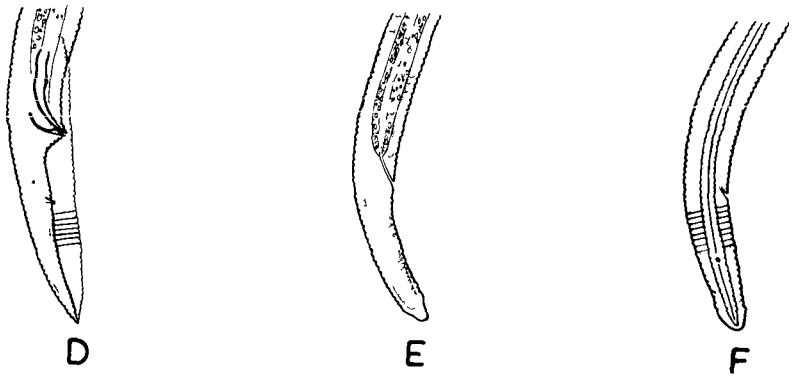
D. Male tail

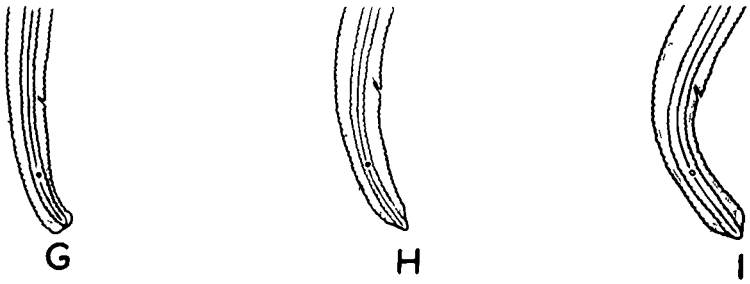
Figs. E-I *Tylenchorhynchus divittatus* Siddiqi, 1961

E. Female tail

F-I. Female tails, surface view


A
B
C
20μ
A


D
E
F
30μ
B-1


G
H
I

P L A T E VI

Figs. A-J *Tylenchorhynchus hexincisus* n. sp.

A. Entire female

B. Head end

C. Esophageal region

D. Cross section through middle of body

E. Lateral fields and longitudinal striae near midbody

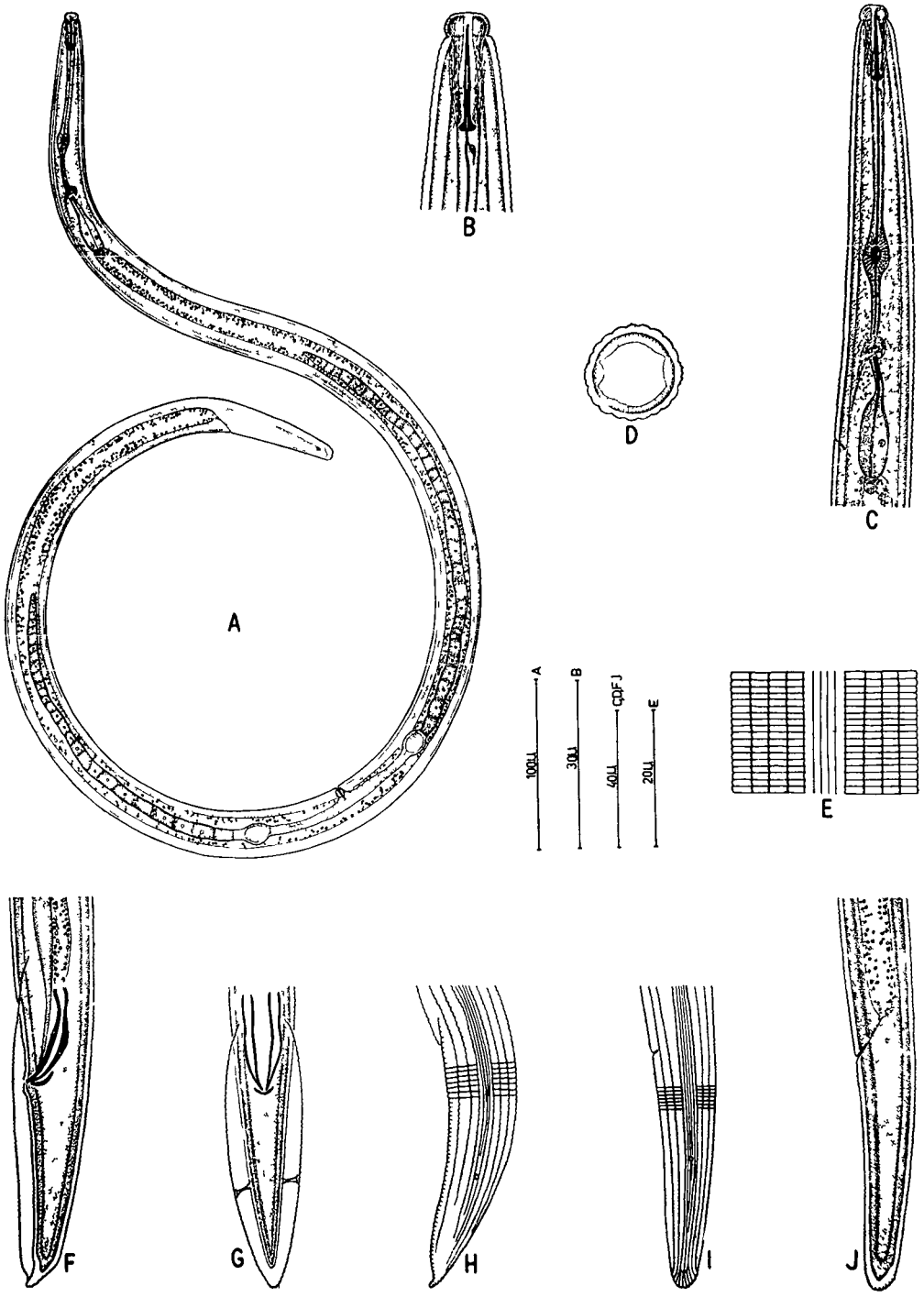
F. Male tail, lateral

G. Male tail, dorsoventral

H. Male tail, surface view

I. Female tail, surface view

J. Female tail, lateral


A
B
C
D
E
F
G
H
I
J
100µ
30µ
40µ
20µ
A
B
CDFJ
E

P L A T E VII

Figs. A-H *Tylenchorhynchus mujtabai* n. sp.

A. Entire female

B. Head end

C. Esophageal region

D. Lateral fields near midbody

E. Female tail

F. Female tail, surface view

G. Male tail

H. Male tail, surface view

A
B
C
D
E
F
G
H
B
H-C
T1E
T1D
A
T1S

P L A T E VIII

Figs. A-M *Telotylenchus historicus* n. sp.

A. Entire female

B. Head end

C. Esophageal region

D&E. Esophageal gland lobes

F. Lateral fields near midbody

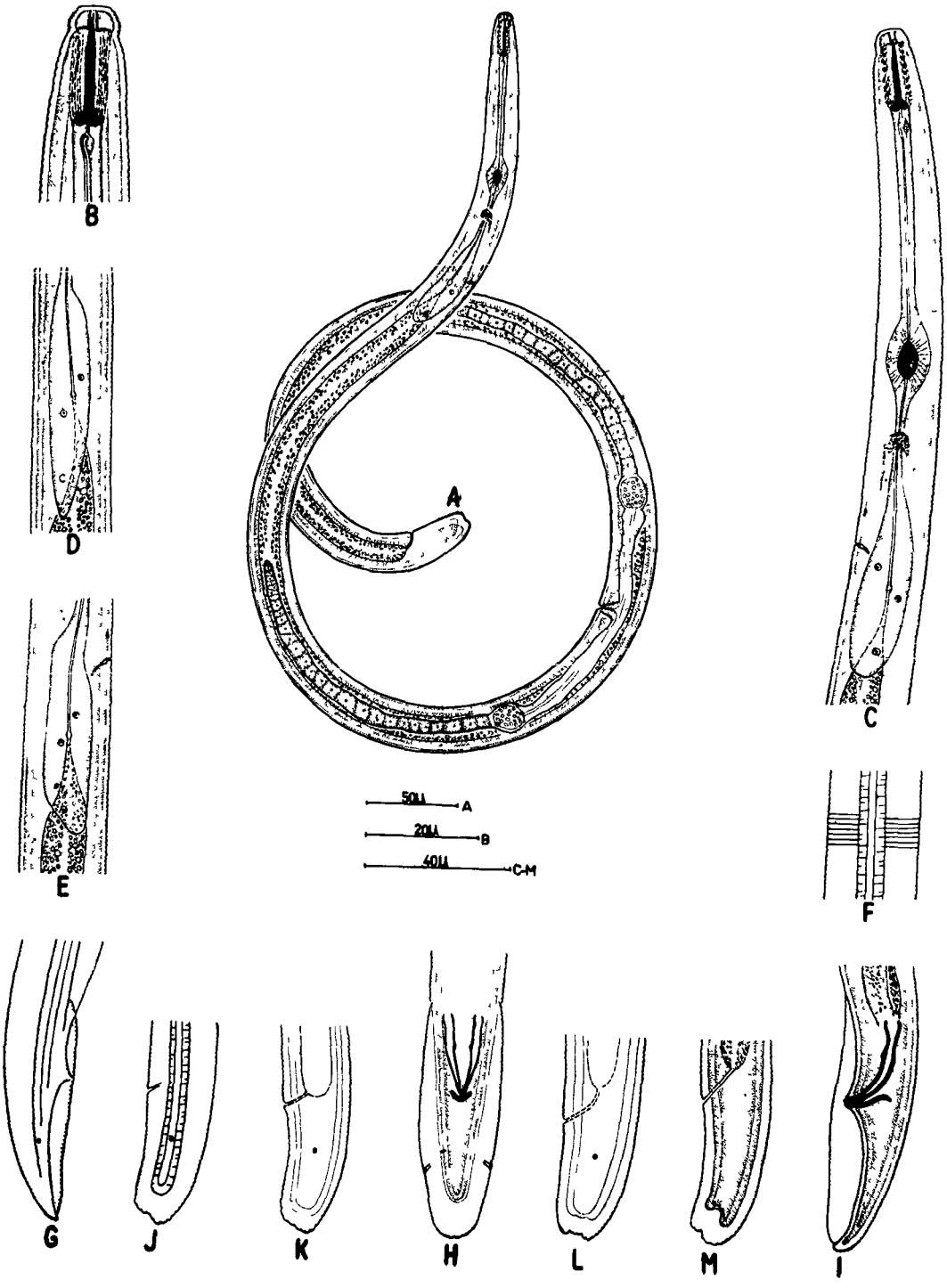
G. Male tail, surface view

H. Male tail, dorsoventral

I. Male tail, lateral

J. Female tail, surface view

K-M. Female tails, lateral


B
A
C
D
E
50µ
A
20µ
B
40µ
C-M
F
G
J
K
H
L
M
I

P L A T E IX

Figs. A-G *Telotylenchus aerolatus* n. sp.

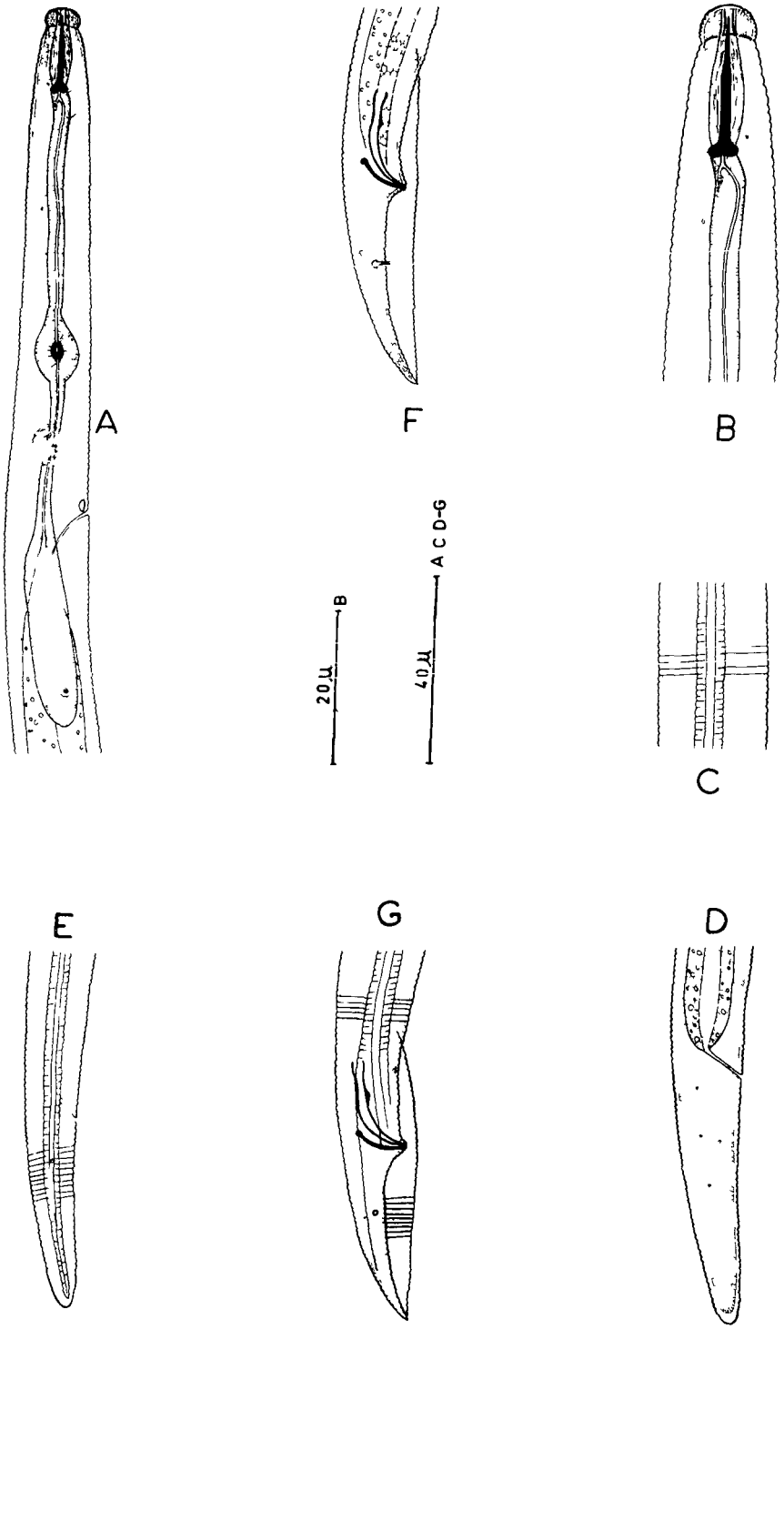
A. Esophageal region

B. Head end

C. Lateral fields near midbody

D&E. Female tails

F&G. Male tails


A
F
B
20 µ
B
40 µ
A C D-G
C
E
G
D

P L A T E X

Figs. A-I *Thornenema baldum* (Thorne, 1939) Andrássy, 1959

A. Head end, Bombay population

B. Head end, Kurnool population

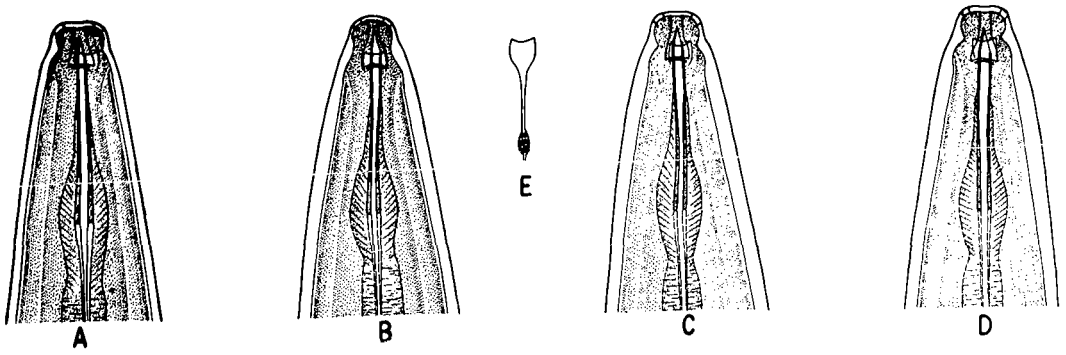
C&D. Head ends of female and male respectively, Tuticorin population

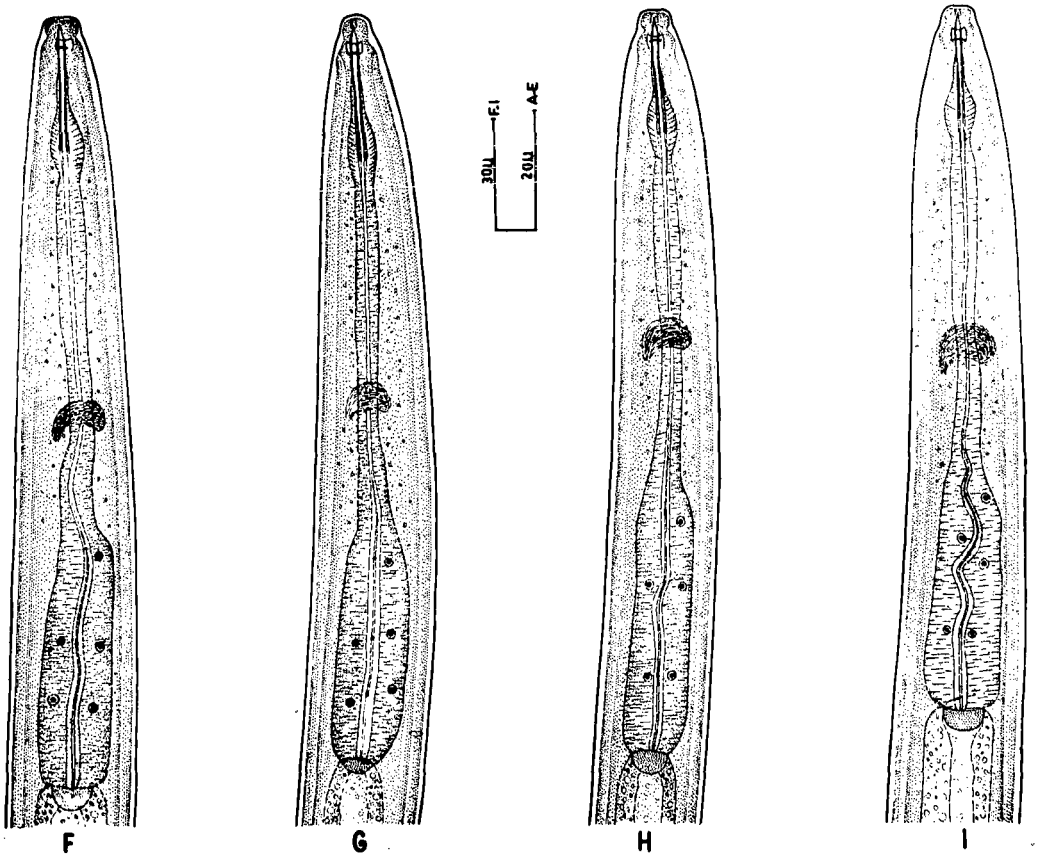
E. Amphid, Kurnool population

F. Esophageal region, Bombay population

G. Esophageal region, Kurnool population

H&I. Esophageal region of female and male respectively, Tuticorin population


A
B
E
C
D


F
G
30µ
F-I
20µ
A-E
H
I

P L A T E XI

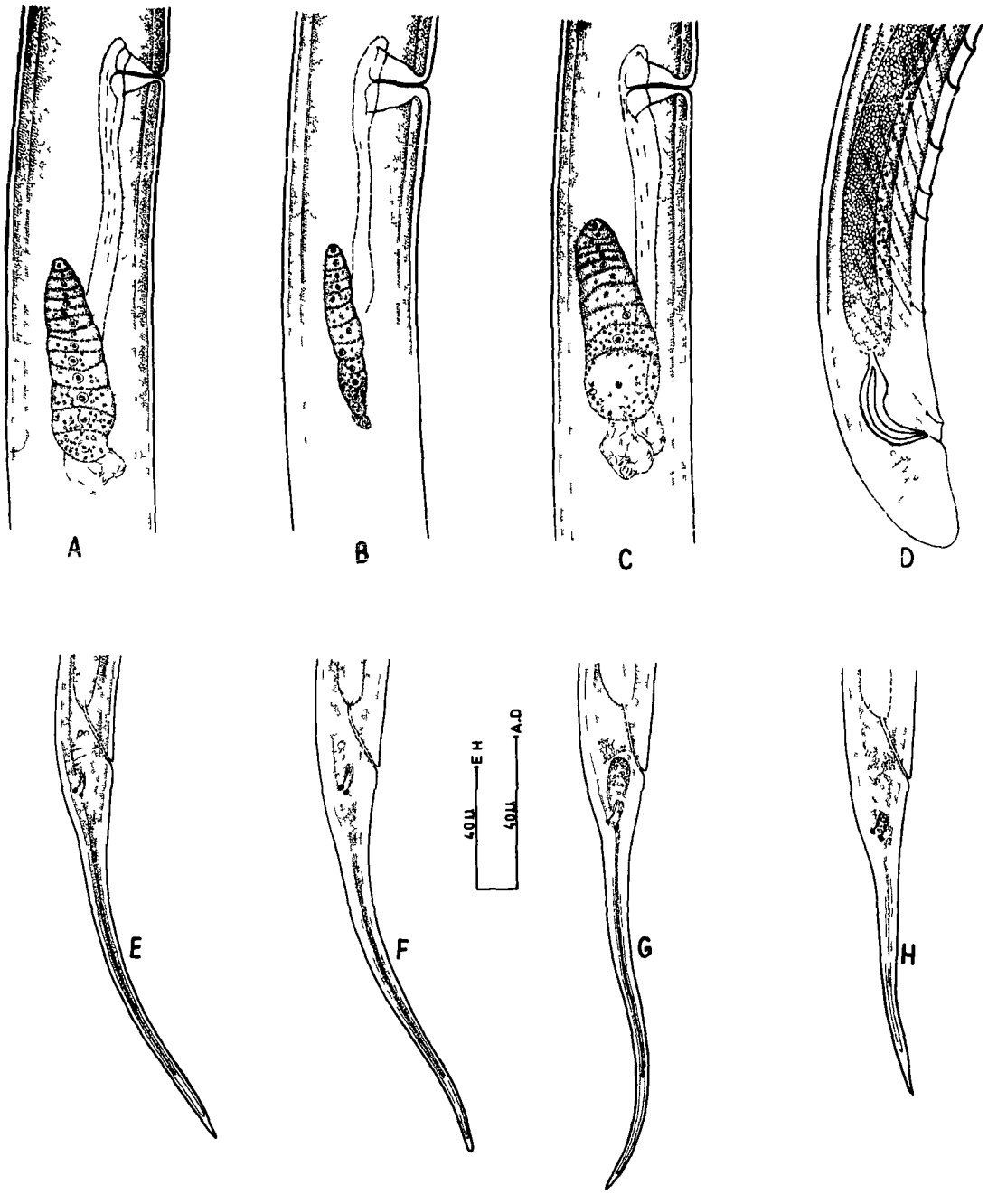
Figs. A-H *Thornenema baldum*

A,B&C. Female gonad of Bombay, Kurnool and Tuticorin populations respectively

D. Male tail

E&F. Female tails of Bombay and Kurnool populations respectively

G&H. Female tail of Tuticorin population


A
B
C
D
E
F
40µ
E H
40µ
A-D
G
H

P L A T E XII

Figs. A-I *Thornenema mauritianum* (Williams, 1959) n. comb.

A. Entire female

B. Actual shape of entire female

C&D. Head ends, lateral

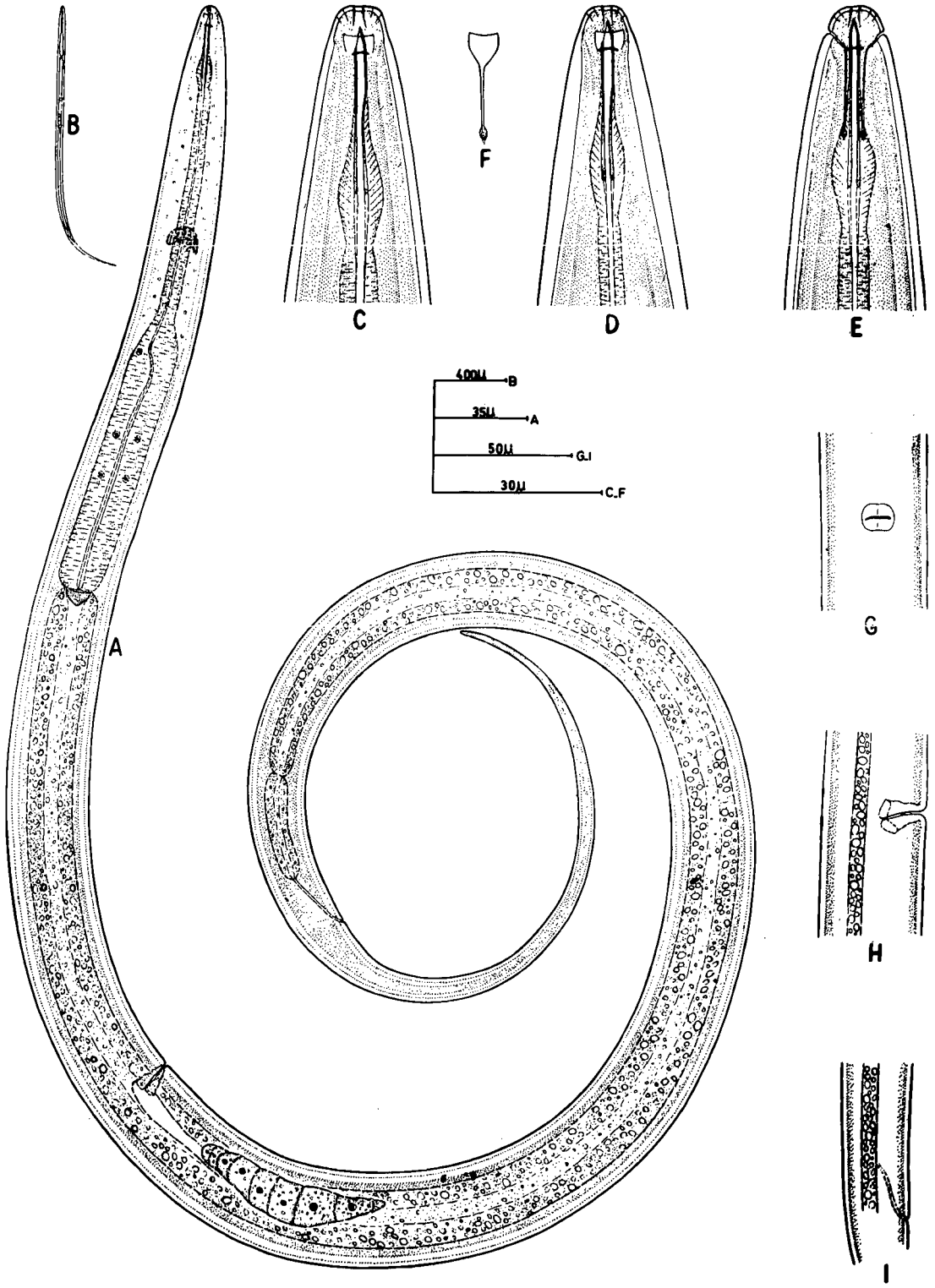
E. Head end dorsoventral

F. Amphid

G. Vulva region

H. Lateral chords at vulva

I. Lateral chords at anus

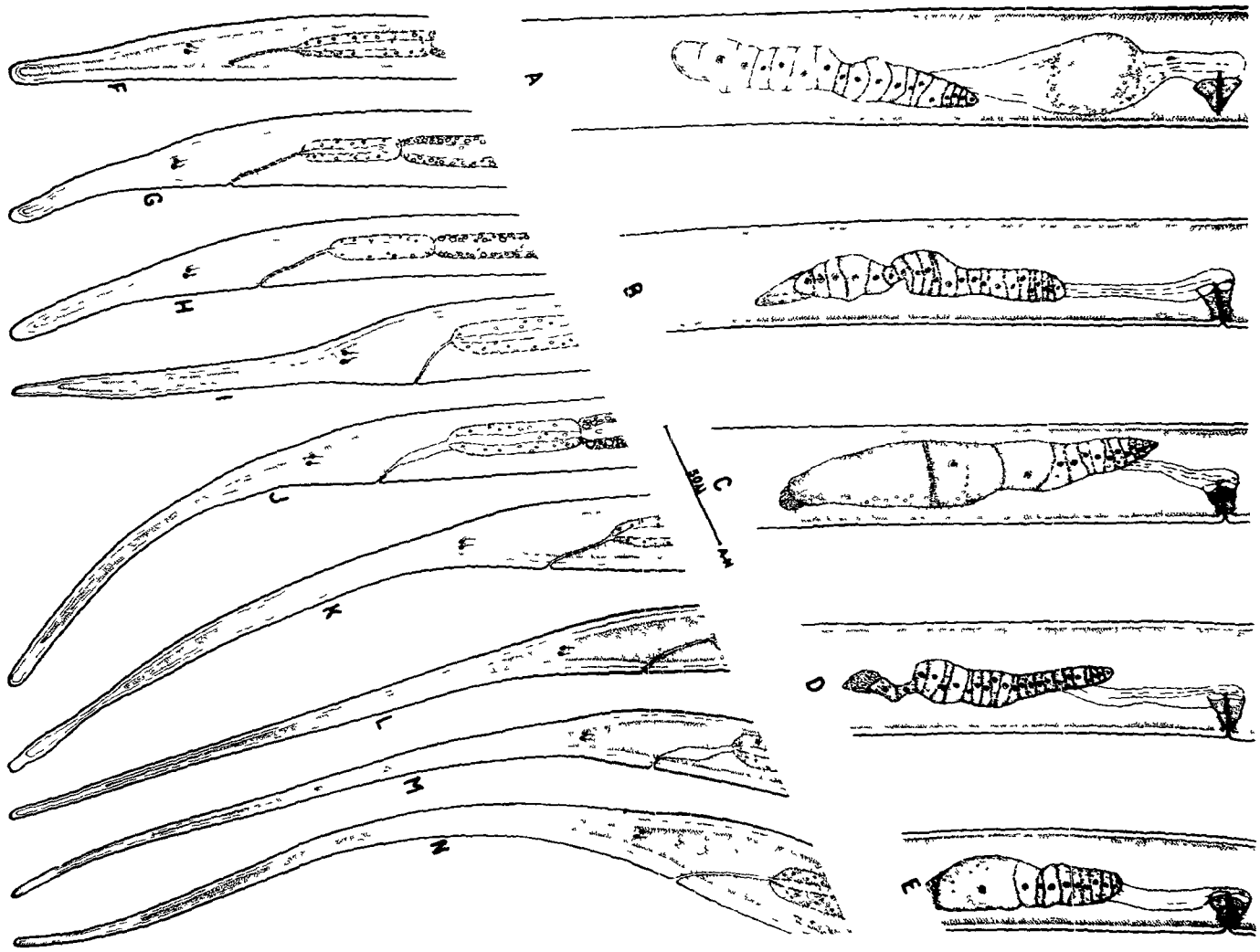

B
C
F
D
E
400µ
B
350
A
50µ
G.I
30µ
C.F
A
G
H
I

P L A T E XIII

Figs. A-N *Thornenema mauritianum*

A-E. Female gonads

F-N. Showing variations in length and shape of tail in Naqvi park, Aligarh population


A
B
C
D
E
F
G
H
I
J
K
L
M
100

P L A T E XIV

Figs. A-K *Willinema indicum* n. sp.

A. Entire female

B. Actual shape of female

C. Head end, lateral view

D. Head end, dorsoventral view

E. Amphid

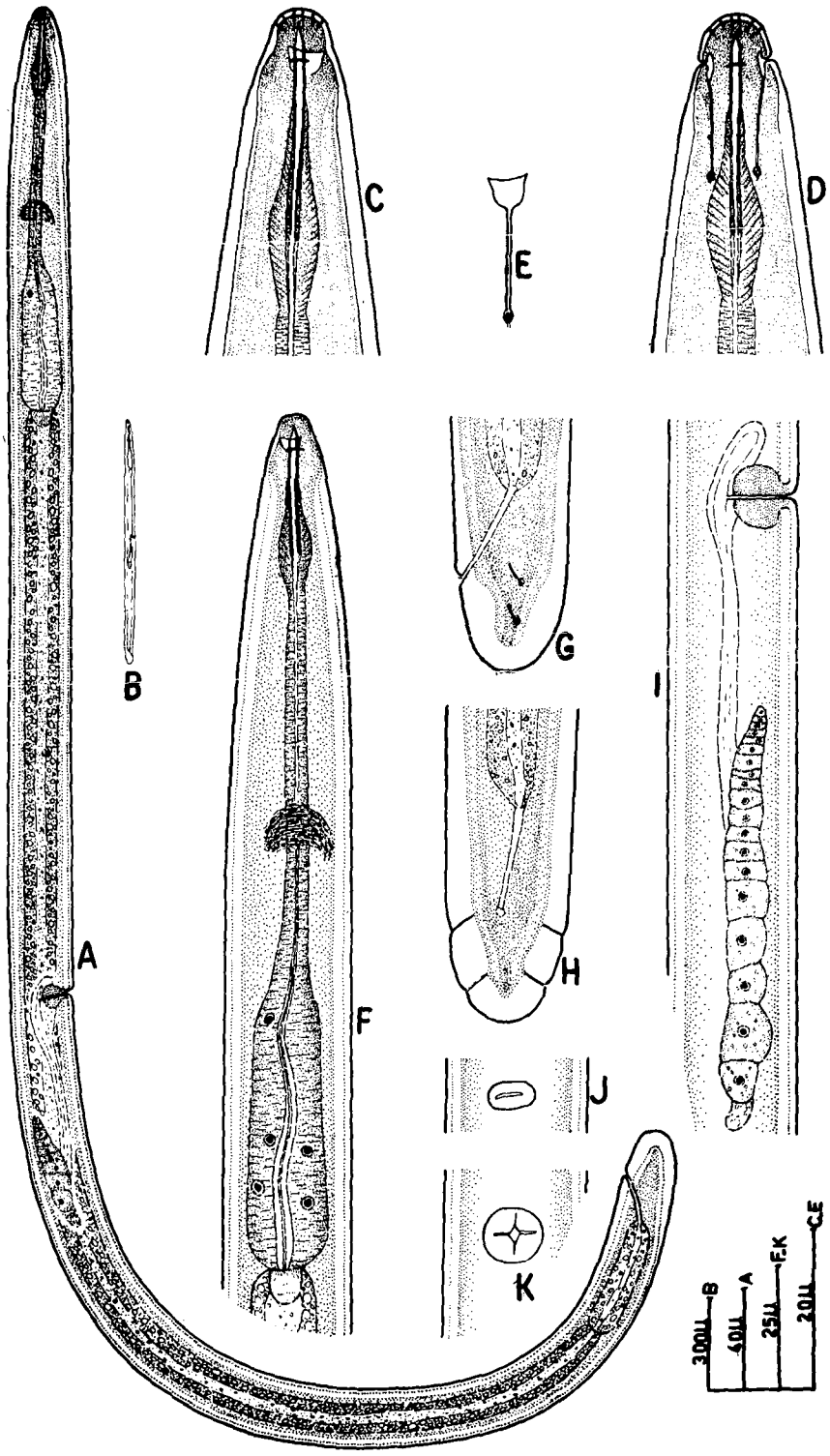
F. Esophageal region

G. Tail, lateral

H. Tail, dorsoventral

I. Female gonad

J&K. Vulva region


A
B
C
D
E
F
G
H
I
J
K
300µ
B
40µ
A
25µ
F.K
20µ
C.E

P L A T E XV

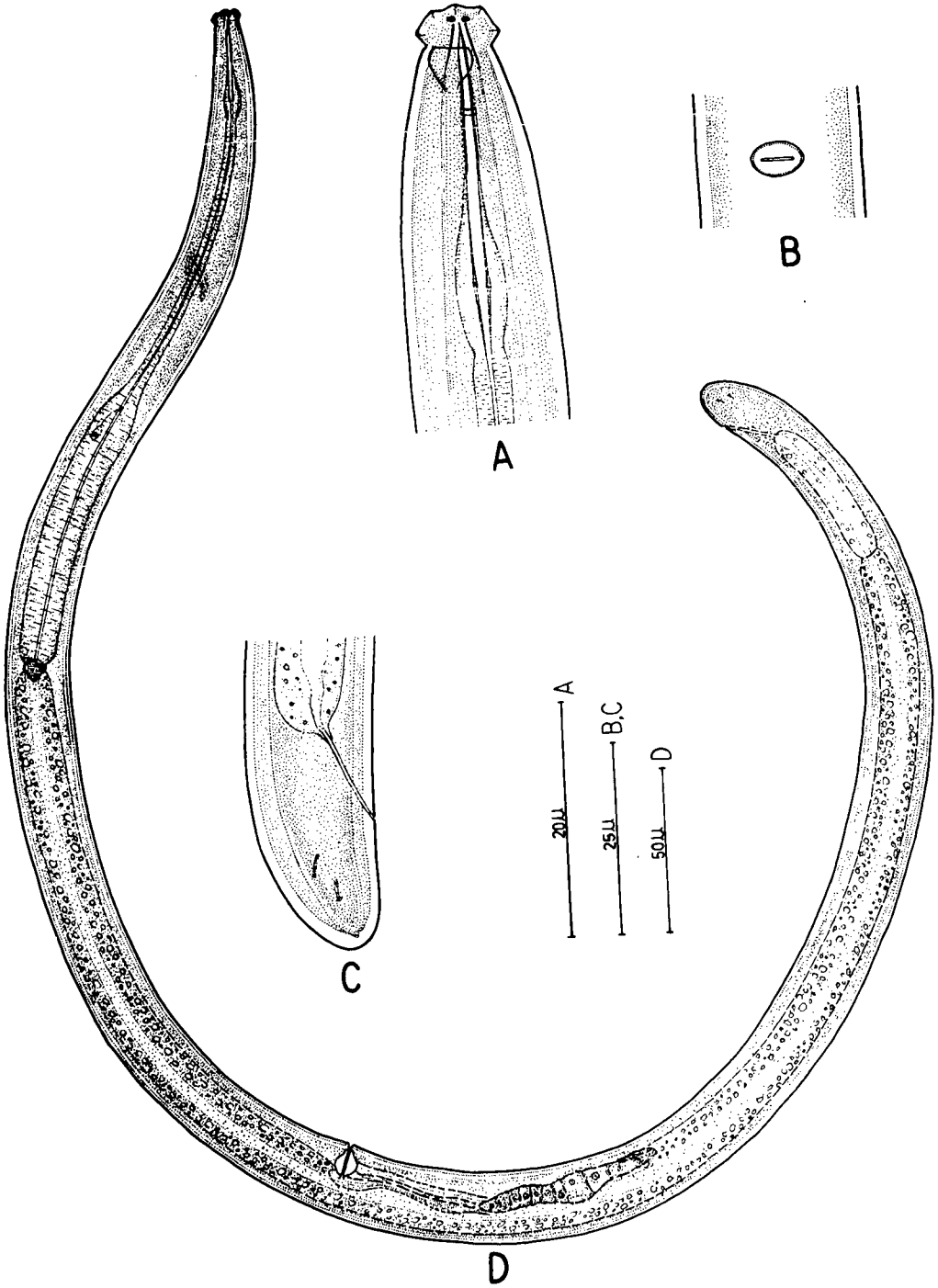
Figs. A-D *Pungentus angulatus* n. sp.

A. Head end

B. Vulva region

C. Female tail

D. Entire female


A
B
C
D
A
B,C
D
20µ
25µ
50µ

P L A T E XVI

Figs. A-E *Discolaimium mazhari* n. sp.

A. Head end

B. Esophageal region

C. Female gonads

D. Female tail

E. Cardia region showing modification

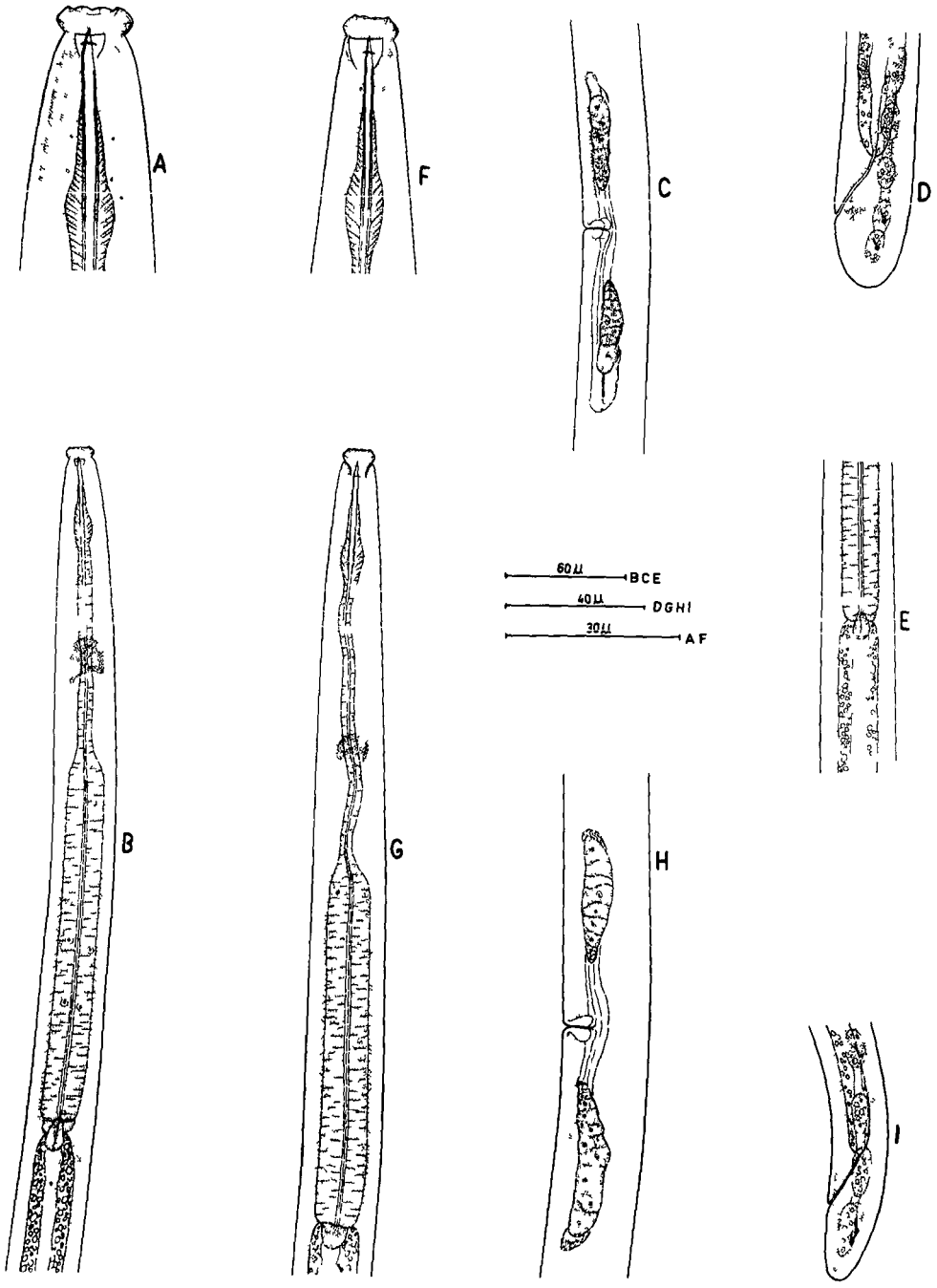
Figs. F-I *Discolaimium upum* n. sp.

F. Head end

G. Esophageal region

H. Female gonads

I. Female tail


A
F
C
D
B
G
60 µ
BCE
40 µ
DGHI
30 µ
AF
E
H
I

P L A T E XVII

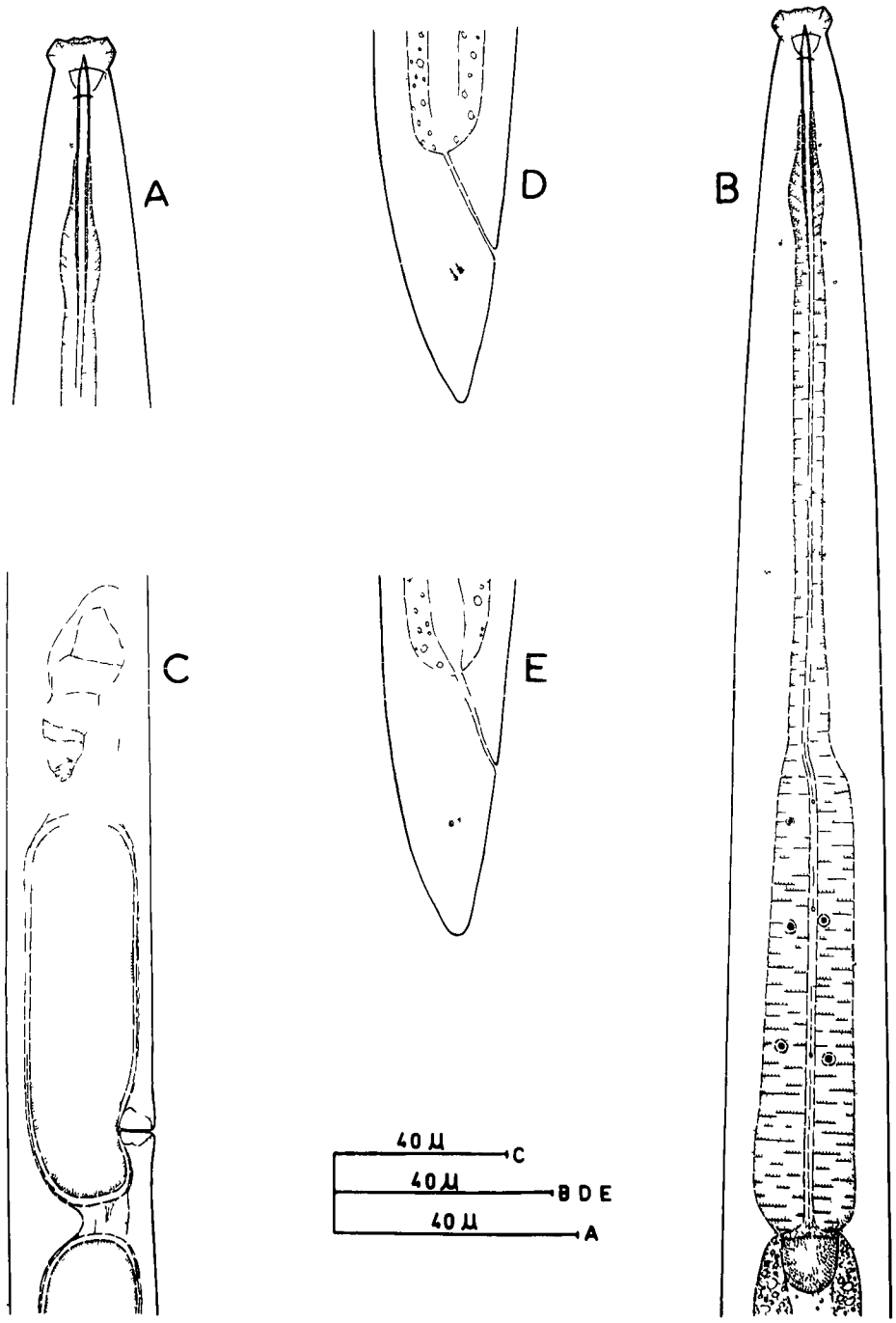
Figs. A-E *Discolaimium mukhtarpuriensis* n. sp.

A. Head end

B. Esophageal region

C. Anterior female gonad

D&E. Female tails


A
D
B
C
E
40 µ
C
40 µ
B D E
40 µ
A

P L A T E XVIII

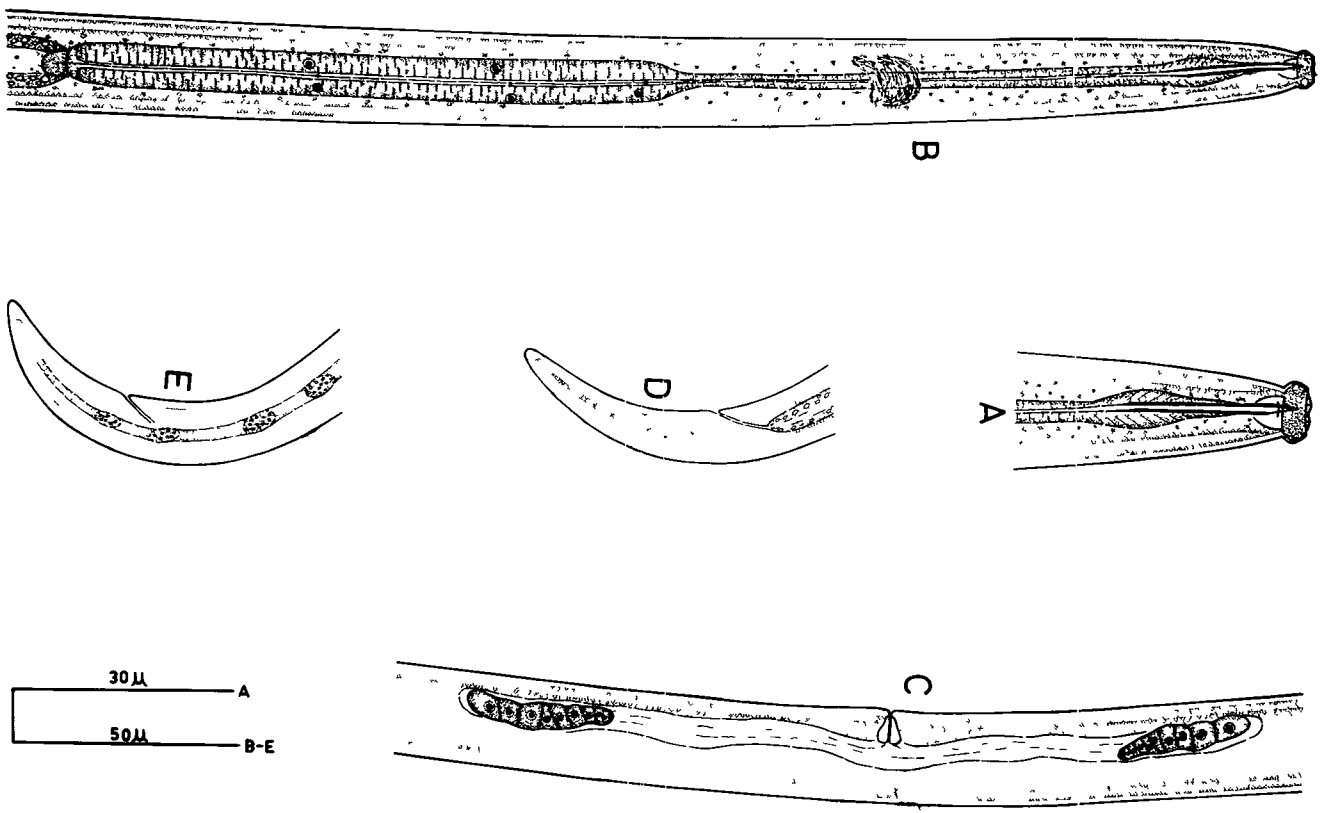
Figs. A-E *Discolaimium longicaudatum* n. sp.

A. Head end

B. Esophageal region

C. Female gonads

D&E. Female tails


B
E
D
A
30µ
A
50µ
B-E
C

P L A T E XIX

Figs. A-G *Aporcelaimellus heynsi* n. sp.

A. Entire female

B. Head end

C. Head end showing modification (Mukhtarpur population)

D. Amphid

E&F. Female tails

G. Vulva region

Figs. H-K *Aporcelaimellus indicus* n. sp.

H. Head end

I. Esophageal region

J. Posterior female gonad

K. Female tail

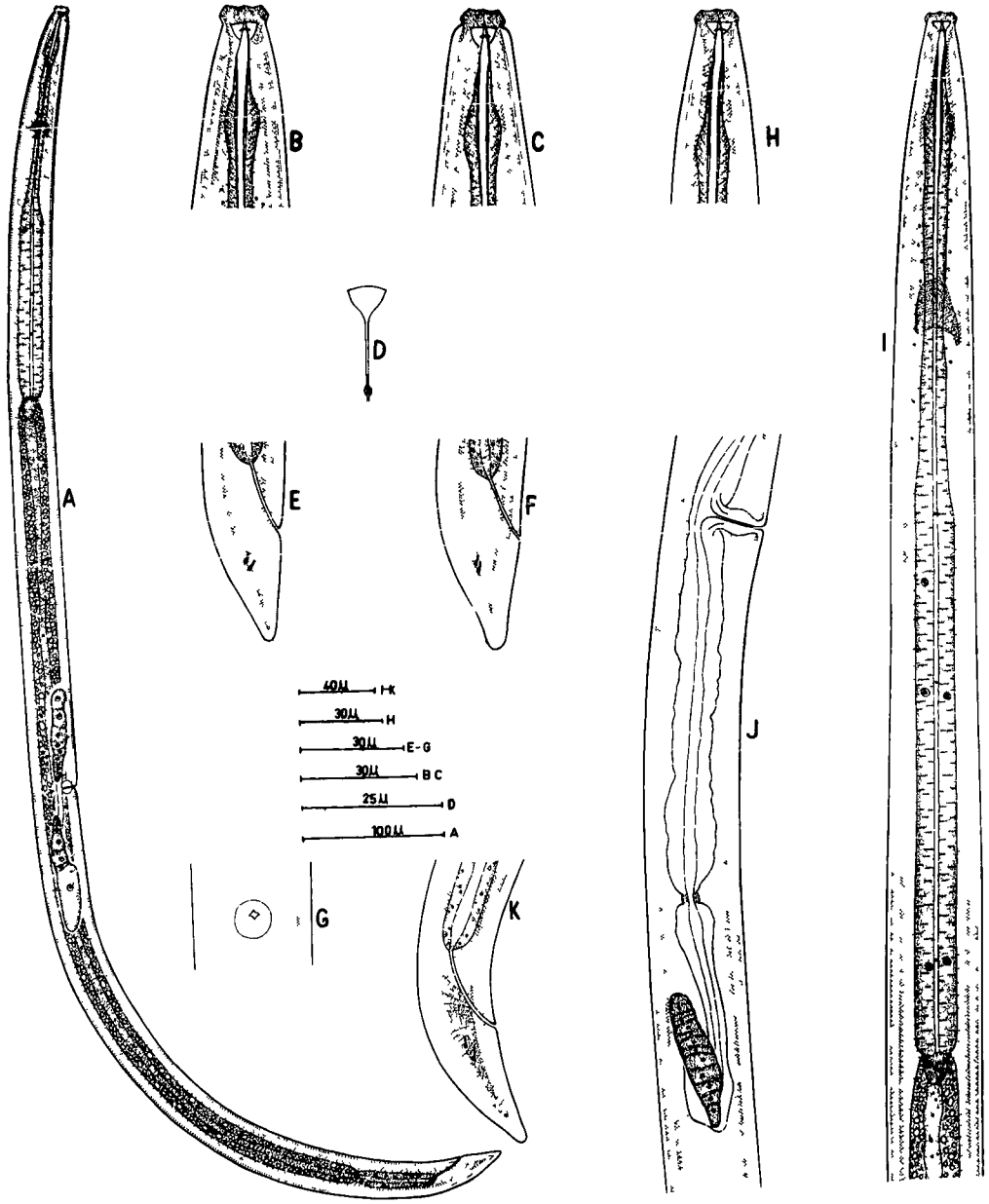

A
B
C
D
E
F
G
H
I
J
K
40µ H-K
30µ H
30µ E-G
30µ B C
25µ D
100µ A

PLATE XX

Figs. A-D *Aporcelaimellus hemicaudatus* n. sp.

A. Esophageal region

B. Head end

C. Female gonad.

D. Female tail

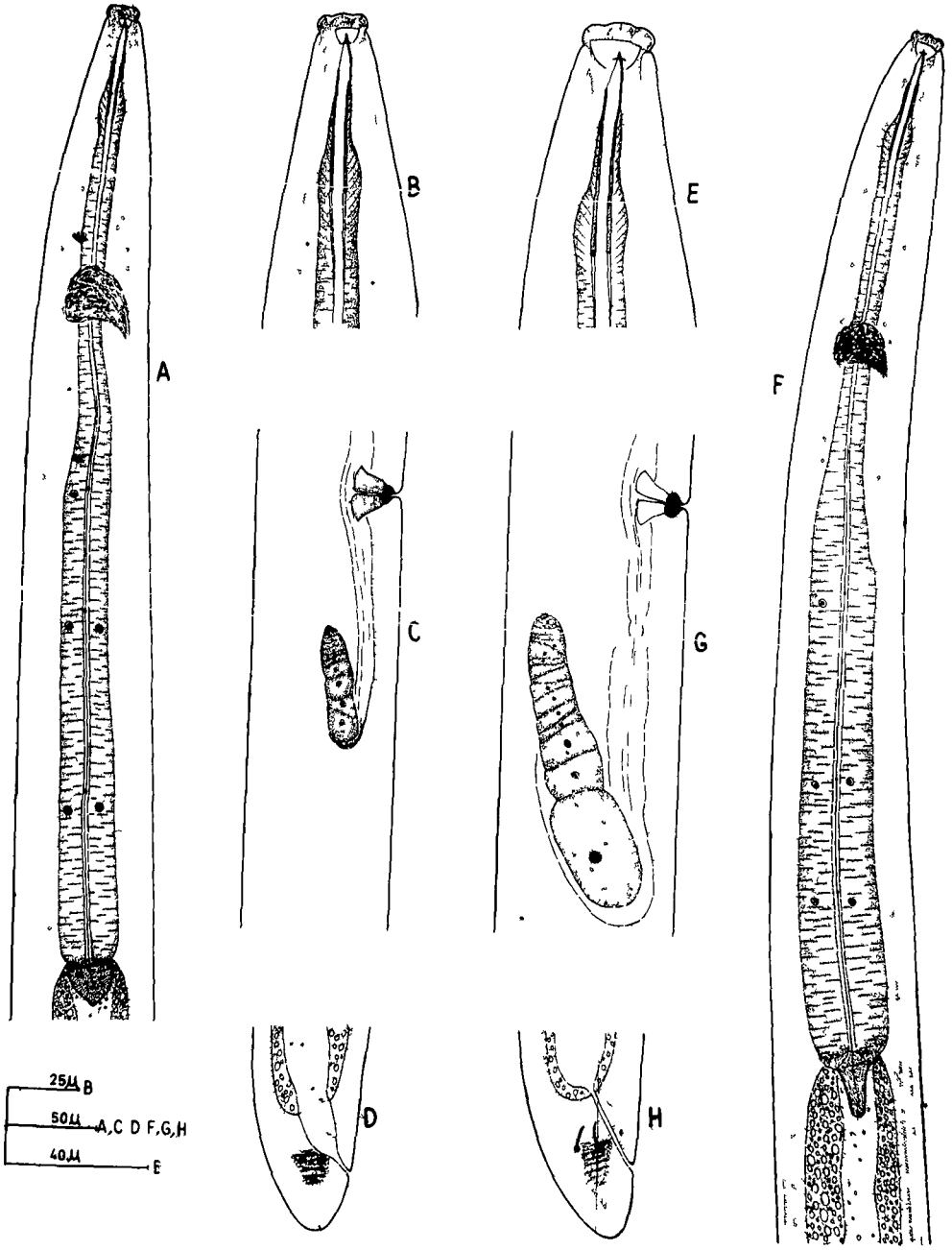
Figs. E-H *Aporcelaimellus raisi* n. sp.

E. Head end

F. Esophageal region

G. Female gonad.

H. Female tail


A
B
C
D
E
F
G
H
25µ B
50µ A,C D F,G,H
40µ E

P L A T E XXI

Figs. A-E *Sectonema procta* n. sp.

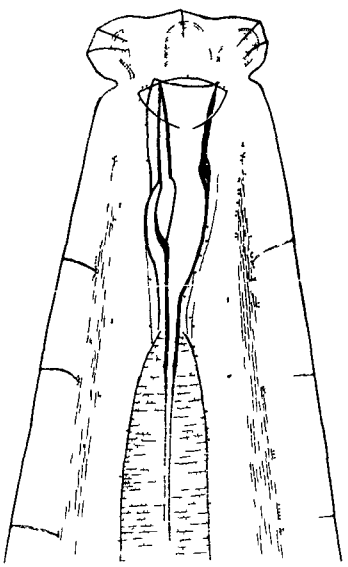
A. Head end

B. Posterior female gonad

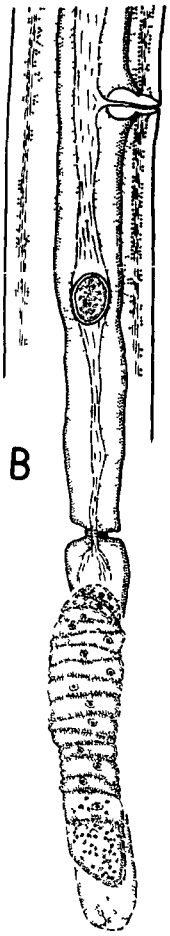
C. Tail tip (female)

D. Female tail

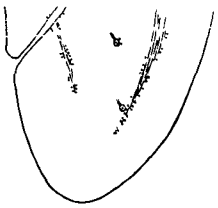
E. Cardia region



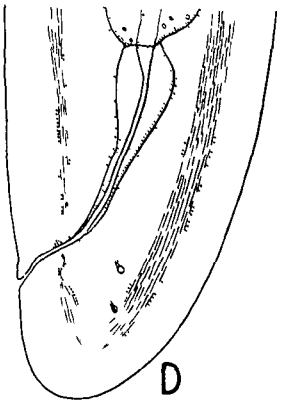
A



B



C

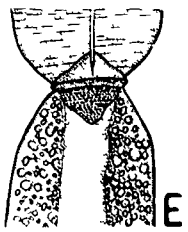


D

20µ A

50µ B

50µ CDE



E

P L A T E XXII

Figs. A-G *Amphidelus novus* n. sp.

A. Head end

B. Amphid

C. Posterior female gonad

D. Female tail

E. Esophageal region

F. Vulva region

G. Male tail

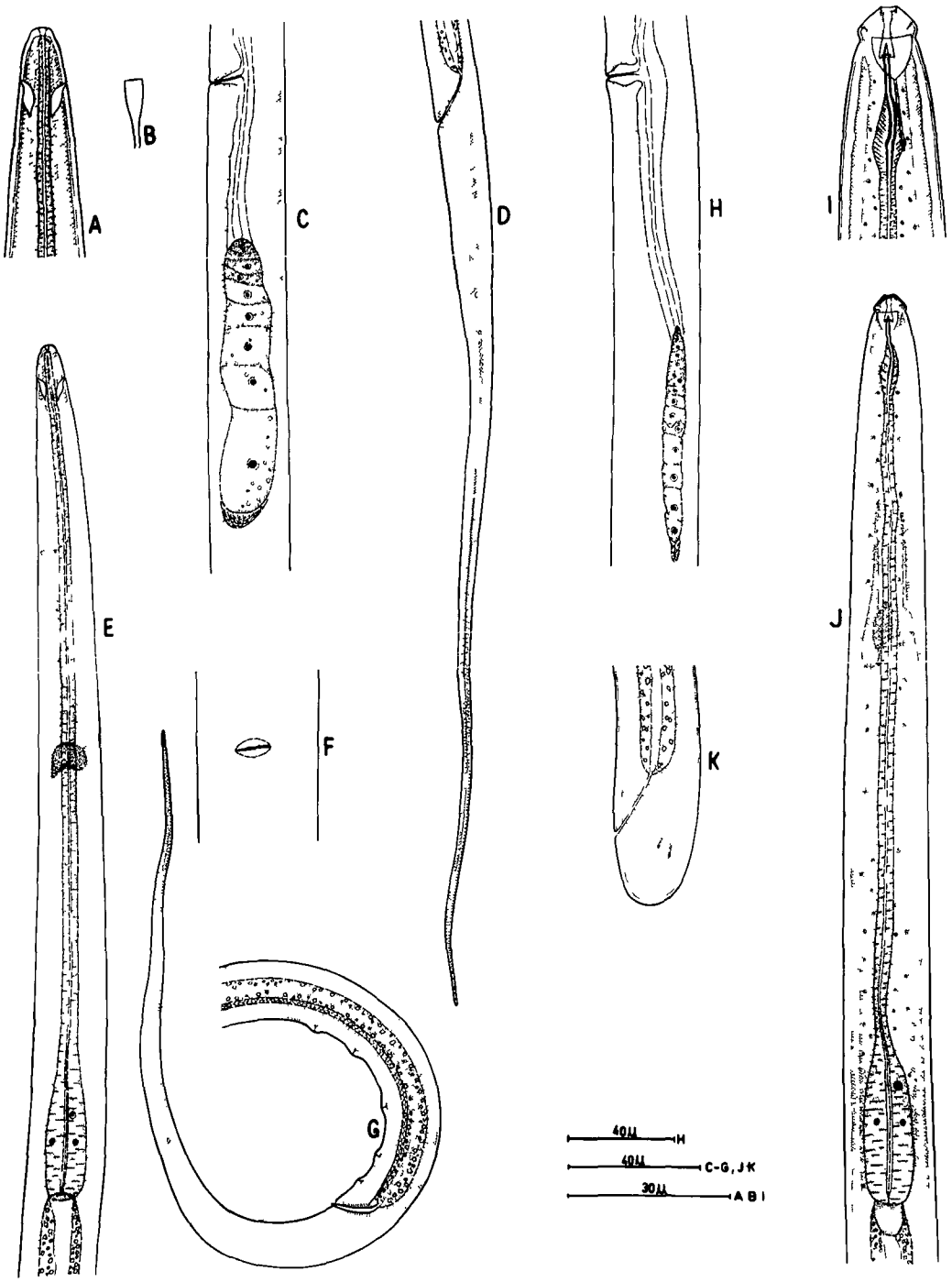
Figs. H-K *Leptonchus capitatus* n. sp.

H. Posterior female gonad

I. Head end

J. Esophageal region

K. Female tail


A
B
C
D
E
F
G
H
I
J
K
40µ
H
40µ
C-G, J-K
30µ
A B I

P L A T E XXIII

Figs. A-C *Dorylaimoides parateres* Siddiqi, 1963

A. Head end

B. Female tail

C. Male tail

Figs. D-J *Dorylaimoides arcuatus* Siddiqi, 1963

D&E. Head end

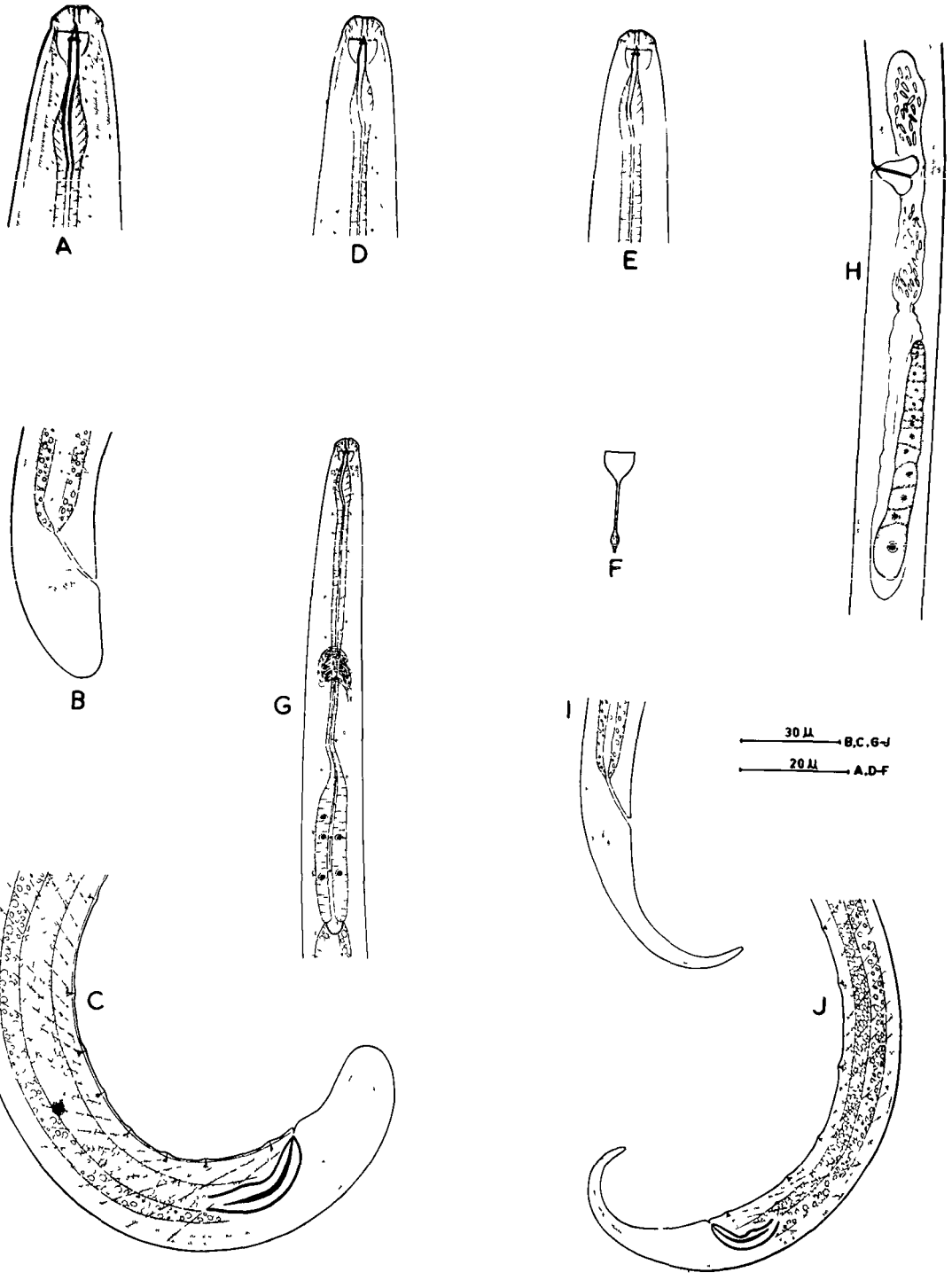
F. Amphid

G. Esophageal region

H. Female gonad

I. Female tail

J. Male tail


A
D
E
H
B
G
F
I
30 µ
B,C,G-J
20 µ
A,D-F
C
J

P L A T E XXIV

Figs. A-G *Dorylaimoides constrictus* n. sp.

A. Entire female

B. Esophageal region

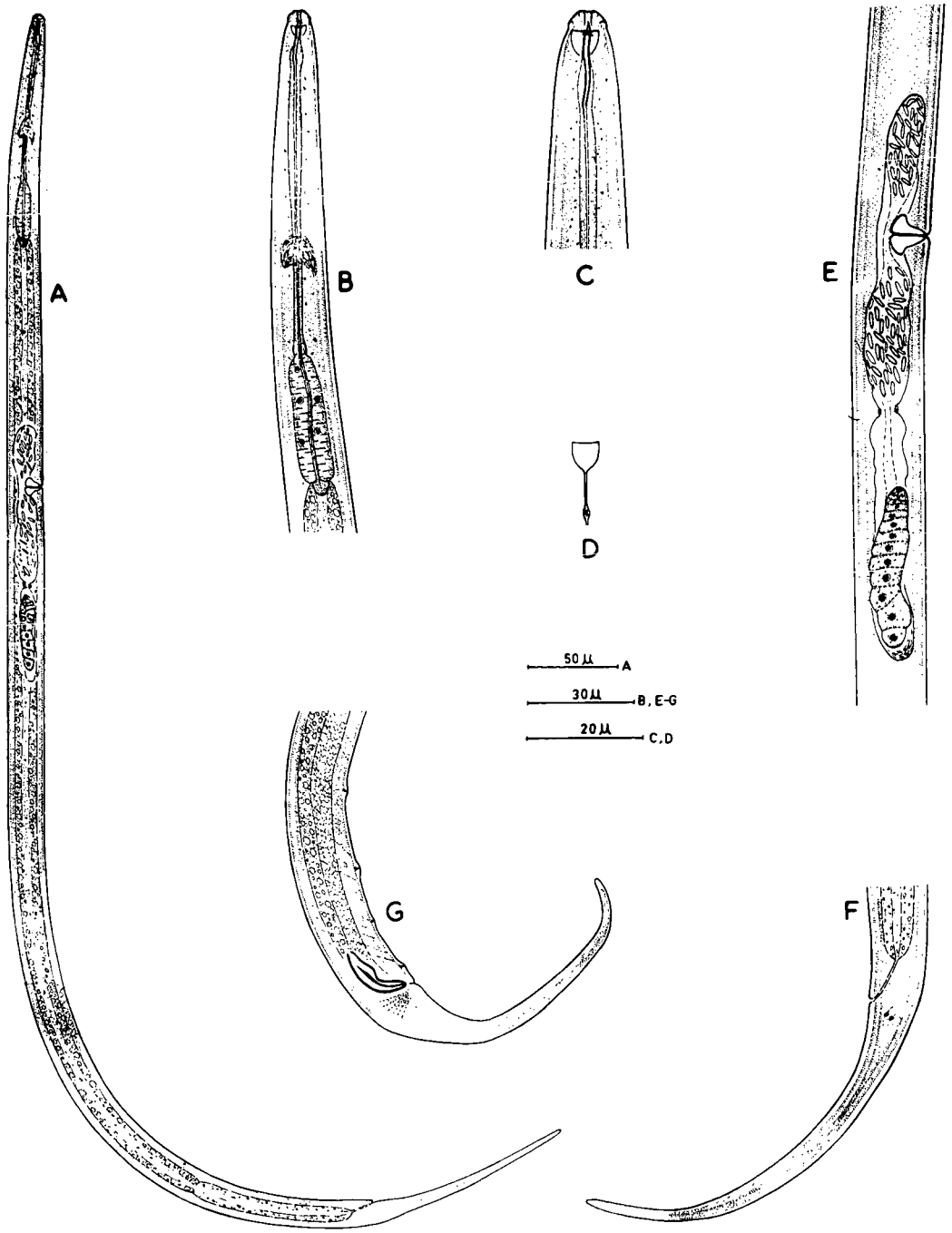
C. Head end

D. Amphid

E. Female gonad

F. Female tail

G. Male tail


A
B
C
D
E
F
G
50 µ
A
30 µ
B, E-G
20 µ
C, D

P L A T E XXV

Figs. A-F *Dorylaimoides arcuicaudatus* n. sp.

A. Head end

B. Esophageal region

C. Amphid

D. Female gonad

E. Female tail

F. Male tail

Figs. G-K *Dorylaimoides grandis* n. sp.

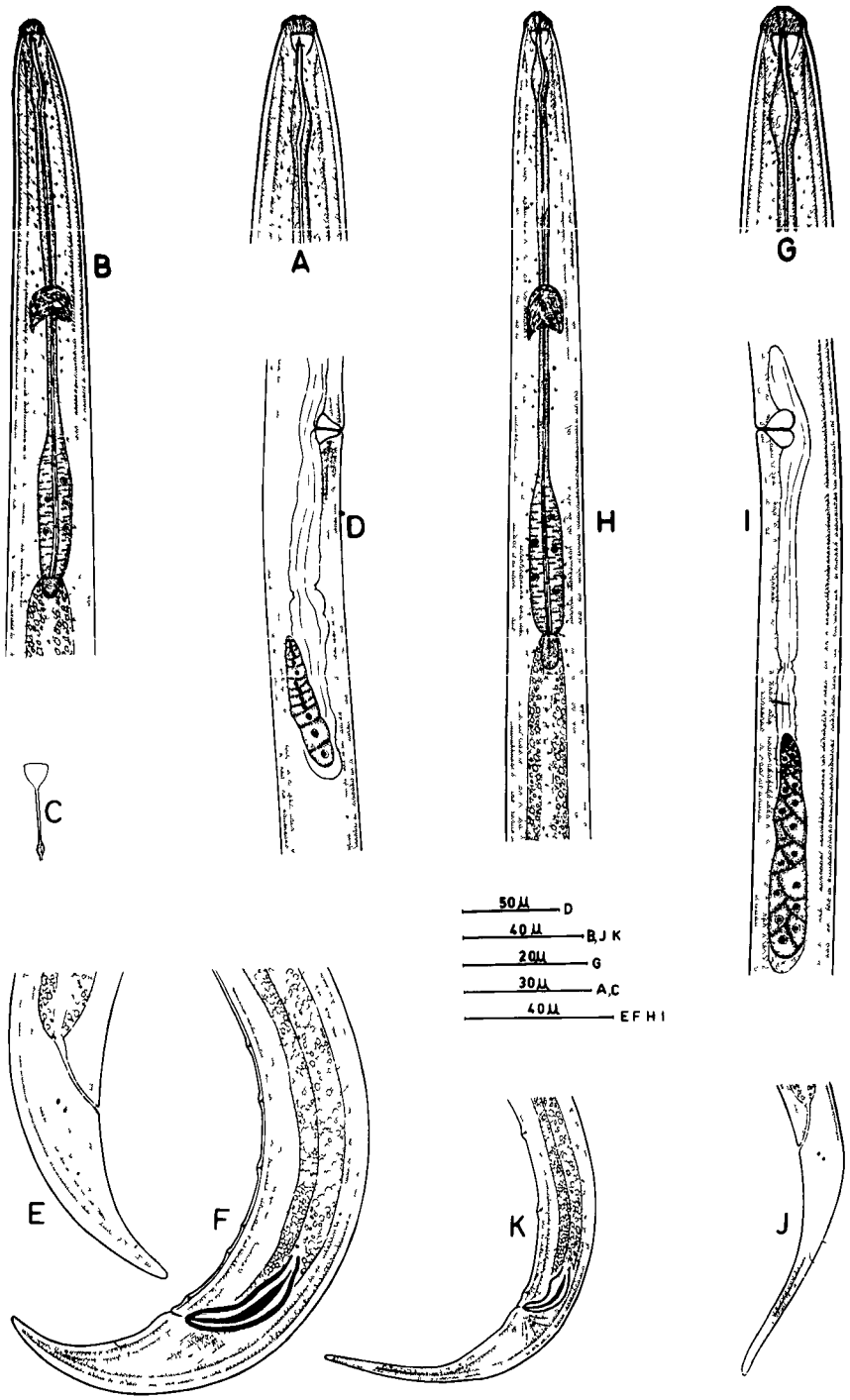
G. Head end

H. Esophageal region

I. Female gonad

J. Female tail

K. Male tail


A
B
C
D
E
F
G
H
I
J
K
50µ D
40µ B,J K
20µ G
30µ A,C
40µ E F H I

P L A T E XXVI

Figs. A-K *Morasia dimorphicauda* n. sp.

A. Entire female

B. Head end

C. Amphid

D. Esophageal region

E. Female gonad

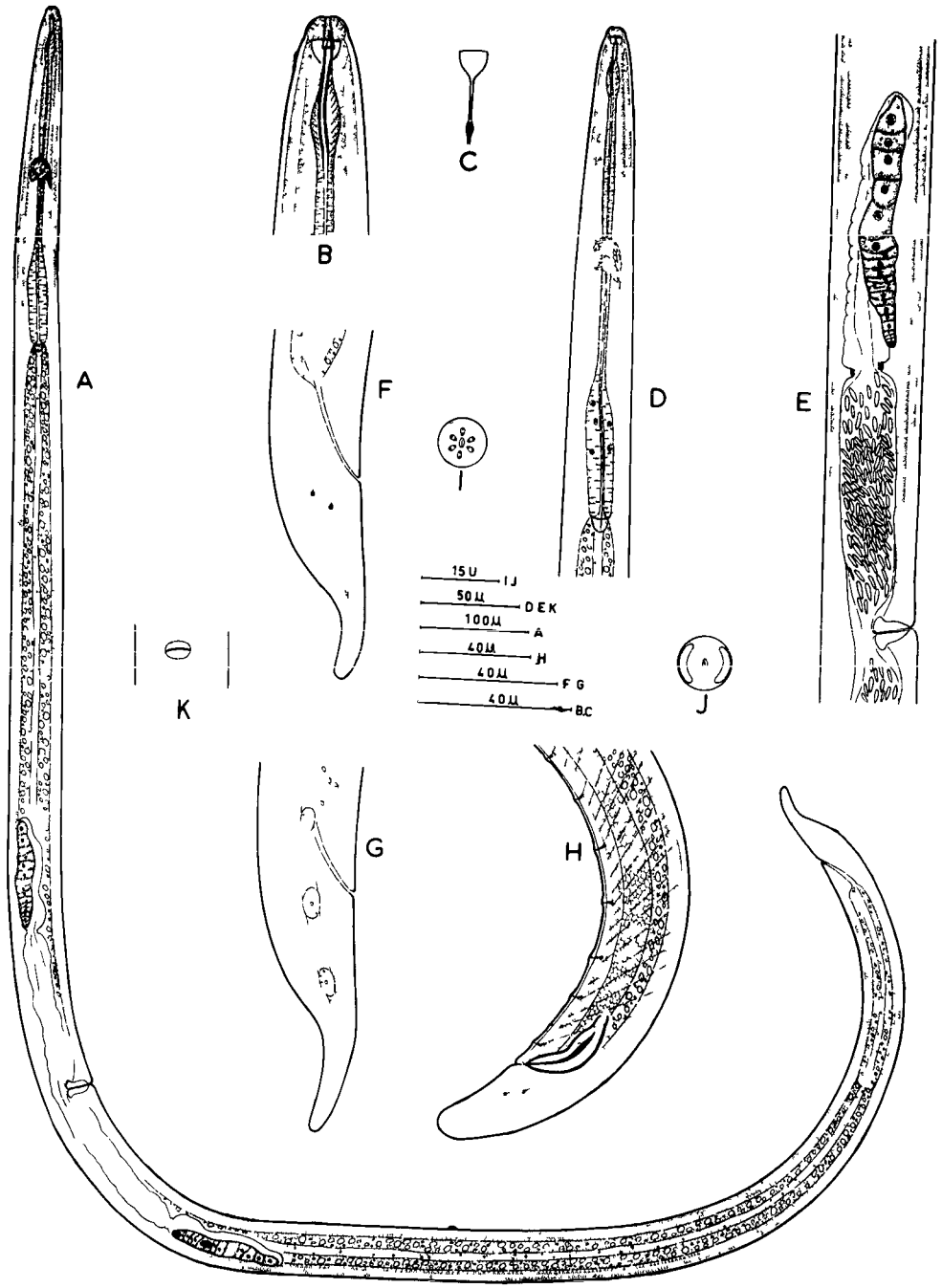
F&G. Female tails

H. Male tail

I. *En face* view

J. C.S. at level of amphidial apertures, 6 μ below anterior end

K. Vulva region


A
B
C
D
E
F
G
H
I
J
K
15 U I J
50 µ D E K
100 µ A
40 µ H
40 µ F G
40 µ B C

P L A T E XXVII

Figs. A-C *Dorylaimellus discocephalus* Siddiqi, 1964

A. Head end, dorsoventral

B&C. Female tails

Figs. D-F *Dorylaimellus indicus* Siddiqi, 1964

D. Head end, dorsoventral

E&F. Female tails

Figs. G-I *Oxydirus magnus* Timm, 1964

G. Head end, lateral

H. Vulva region

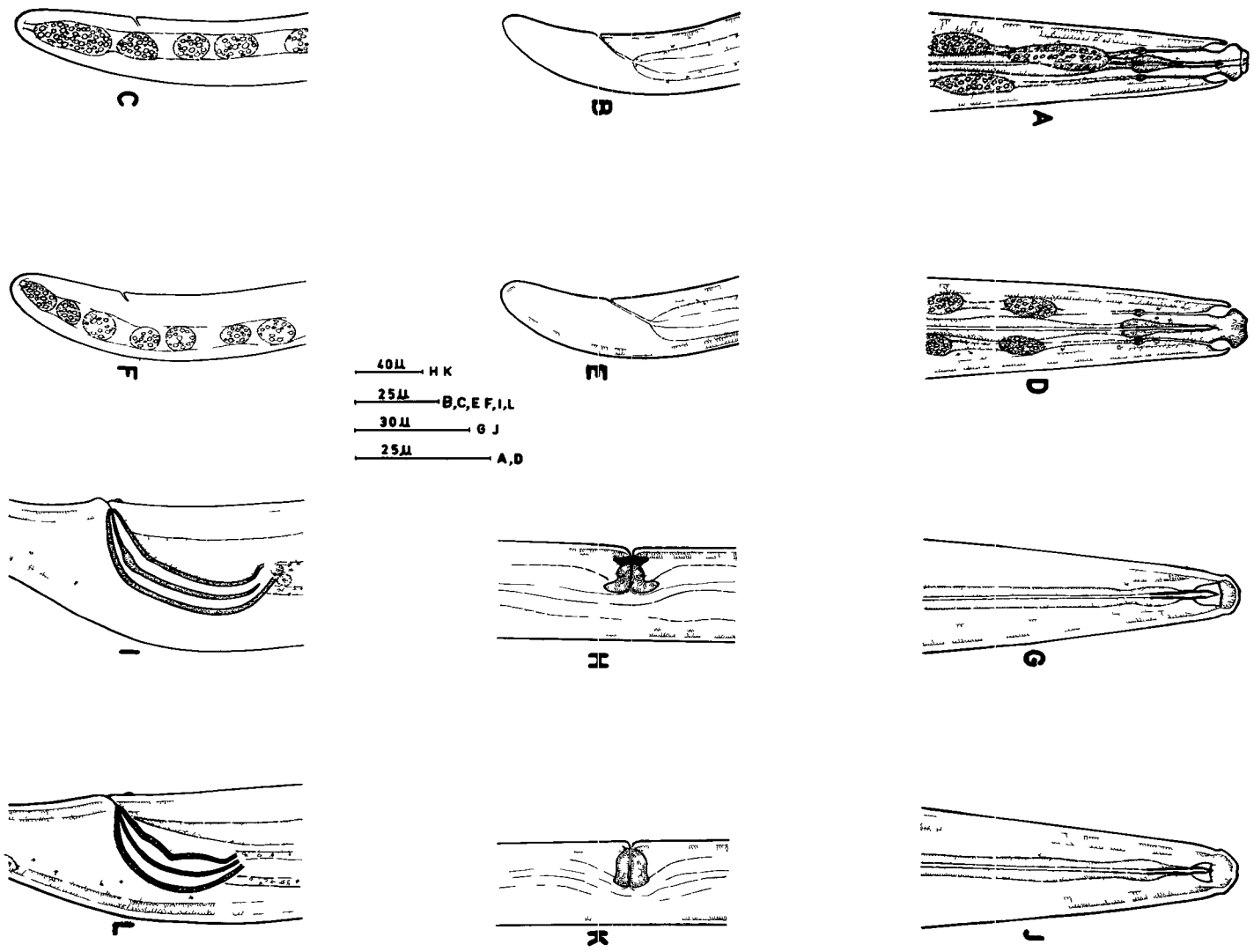
I. Spicules region

Figs. J-L *Oxydirus gigas* Jairajpuri, 1964

J. Head end, lateral

K. Vulva region

L. Spicules region


C
B
A
F
E
D
40µ H K
25µ B,C,E F,I,L
30µ G J
25µ A,D
I
H
G
L
K
J

P L A T E XXVIII

Figs. A-F *Dorylaimellus parvus* Jairajpuri, 1965

A. Head end, lateral

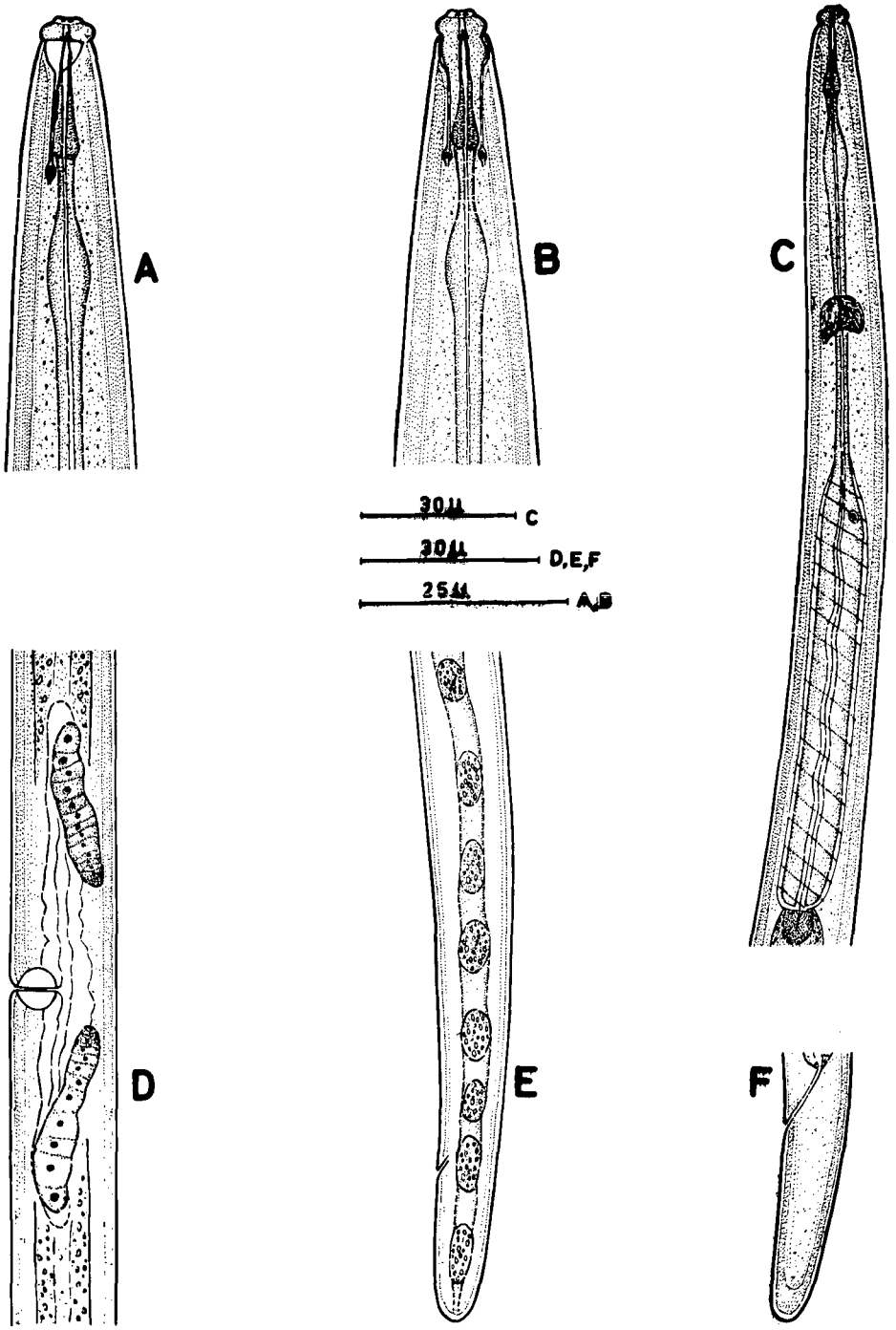
B. Head end, dorsoventral

C. Esophageal region

D. Female gonads

E. Posterior end of body showing lateral hypodermal chords

F. Female tail


A
B
C
30µ
C
30µ
D,E,F
25µ
A,B
D
E
F

P L A T E XXIX

Figs. A-I *Dorylaimellus jacobi* n. sp.

A. Entire female

B. Head end, lateral

C. Head end, dorsoventral

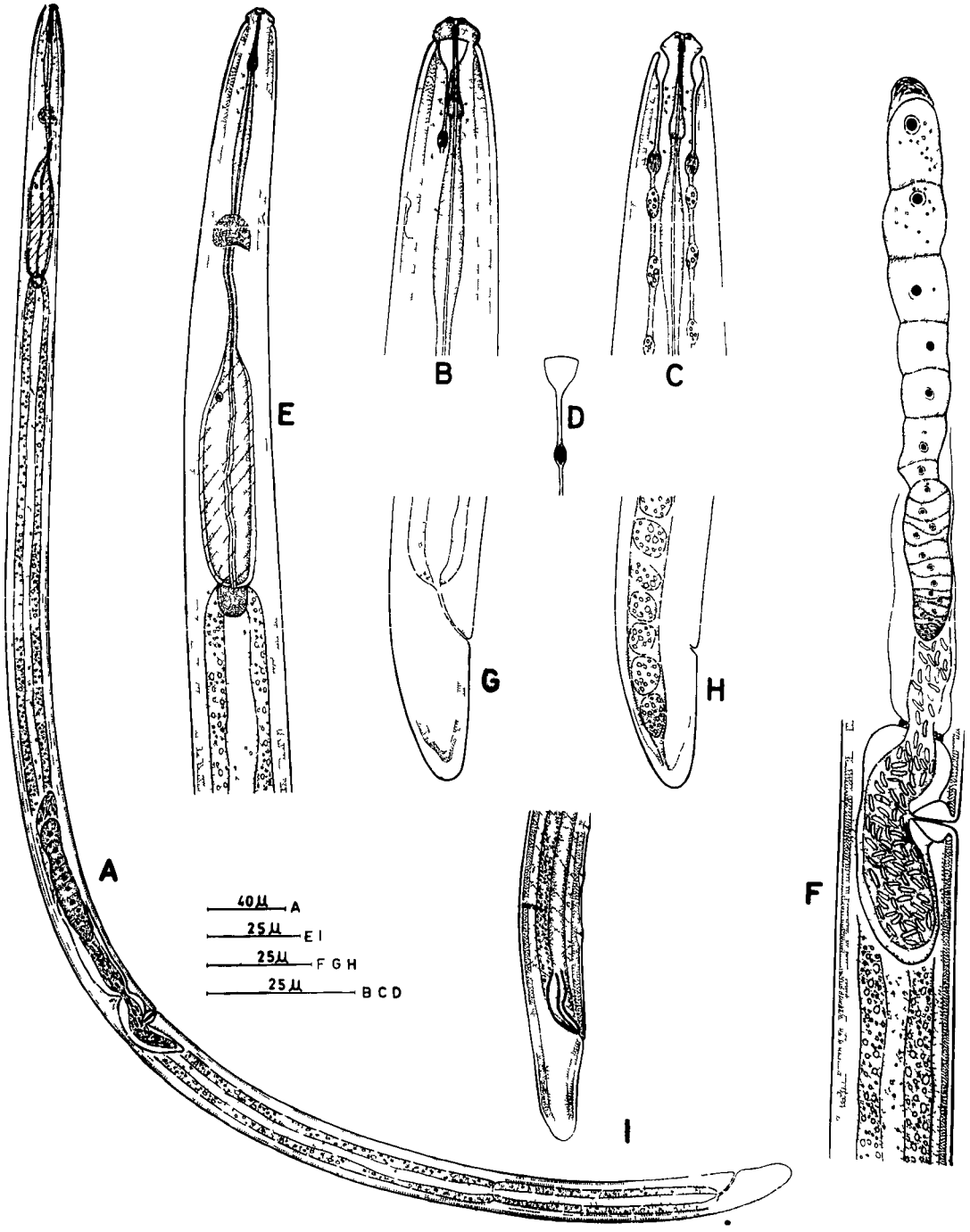
D. Amphid

E. Esophageal region

F. Female gonad

G&H. Female tails

I. Male tail


A
B
C
D
E
F
G
H
I
40µ A
25µ E I
25µ F G H
25µ B C D

P L A T E XXX

Figs. A-F *Dorylaimellus deviatus* n. sp.

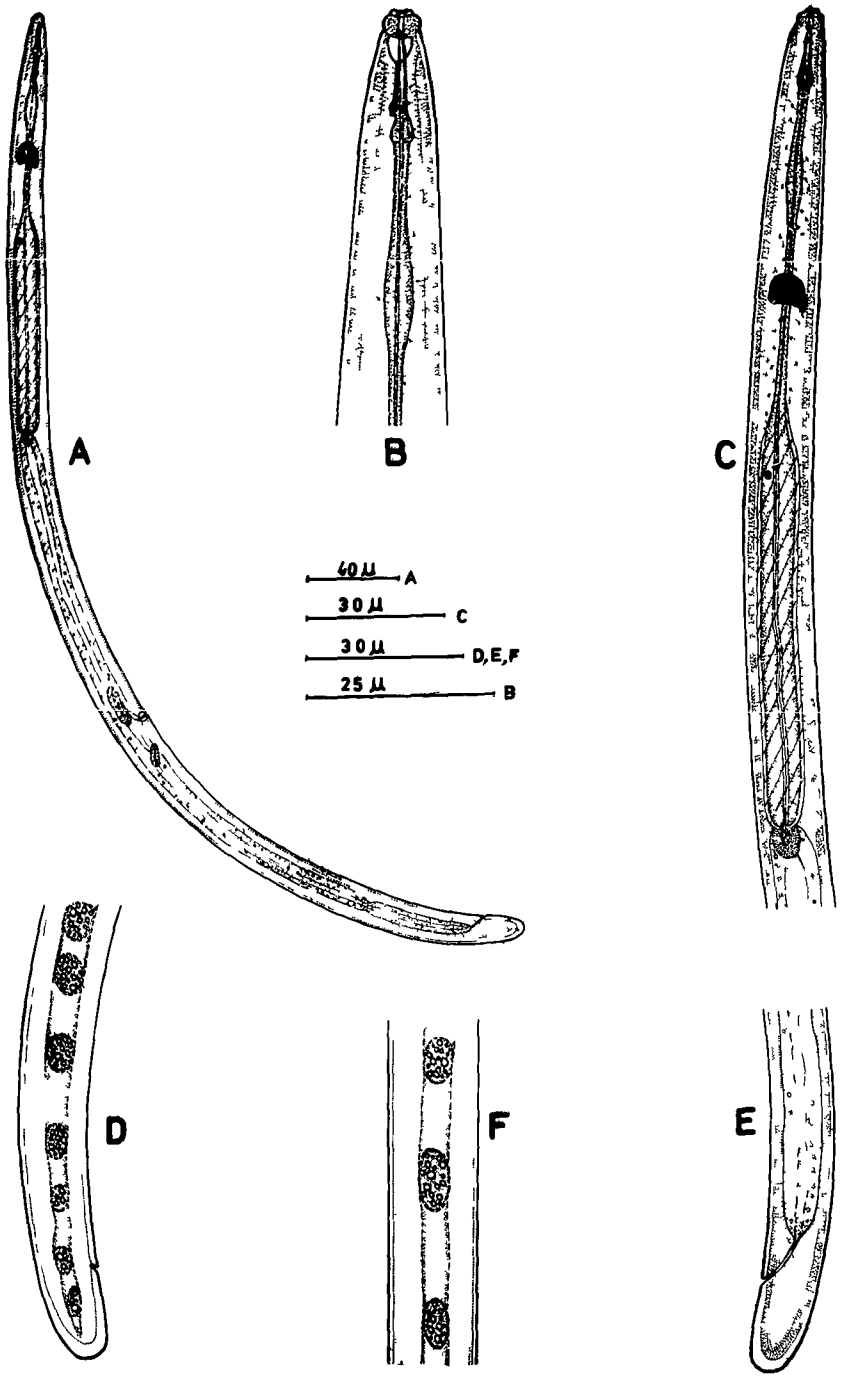
A. Entire female

B. Head end, lateral

C. Esophageal region

D&E. Female tails

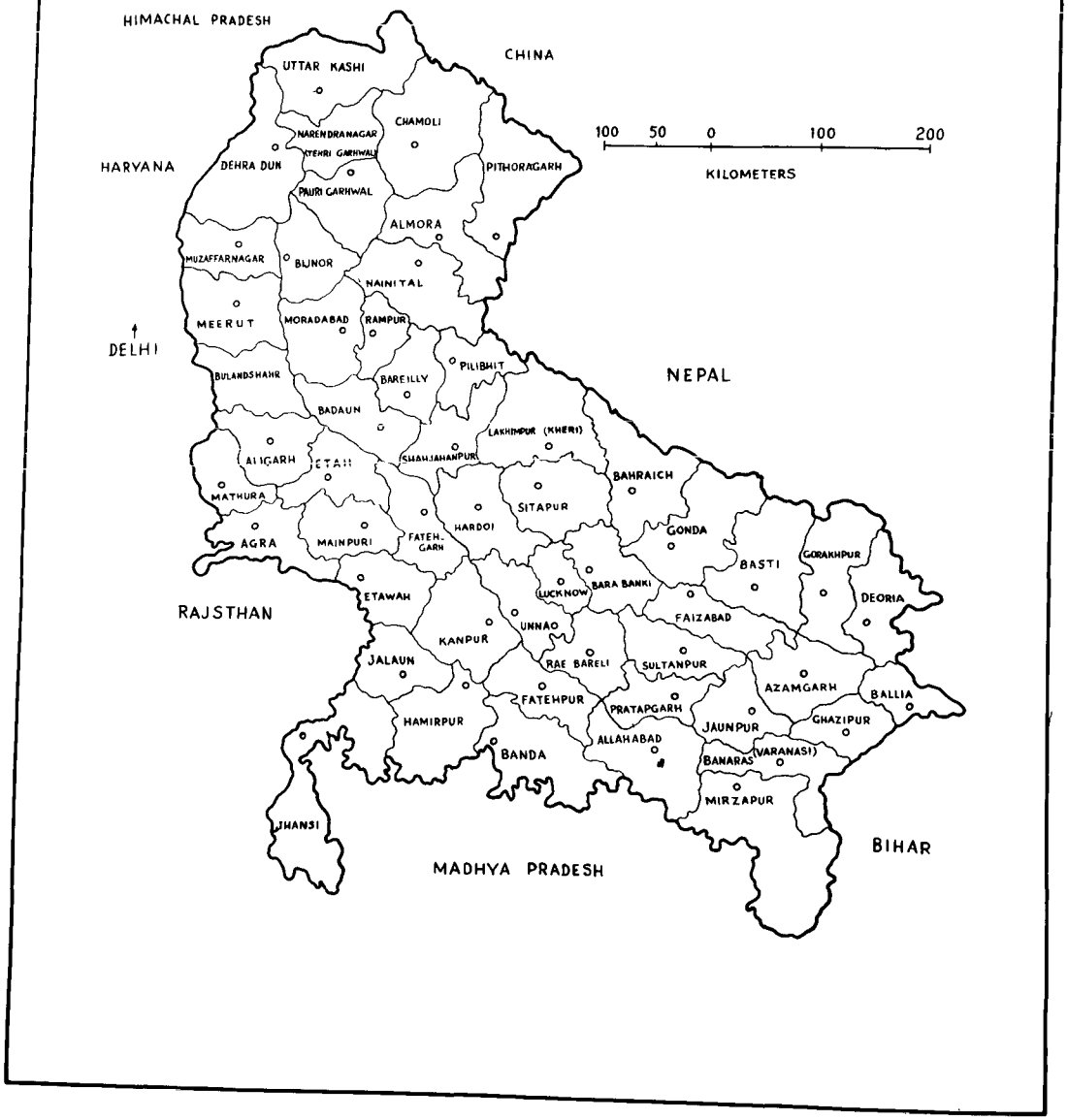
F. Lateral hypodermal chords near midbody


A
B
C
40 µ
A
30 µ
C
30 µ
D,E,F
25 µ
B
D
F
E

P L A T E XXXI

Map of Uttar Pradesh

MAP OF UTTAR PRADESH



A B S T R A C T

STUDY OF THE NEMATODES ASSOCIATED WITH FIBROUS CROPS

By

QAISER HUSAIN BAQRI

The present research project was started in January, 1966. A large number of samples was collected from soil around roots of 3 species of cotton, Gossypium hirsutum L., G. herbaceum L. and G. arboreum L.; the sun hemp, Crotalaria juncea L. and the patson, Hibiscus cannabinus L. These samples upon analysis yielded 2 new genera, 53 known genera, 24 new species and 76 known species belonging to 24 families of the Orders Tylenchida and Dorylaimida. Eleven of the known species have been recorded for the first time from India. The present work gives the geographical distribution of the nematodes associated with fibrous crops and provides an account on the quantitative estimation of nematodes associated with cotton in the major cotton growing districts of Uttar Pradesh.

The Order Tylenchida is represented by 9 families. Under the family Tylenchidae 5 new and 19 known species are reported. The new species are Clavilenchus ritteri, Tylenchorhynchus hexincisus, T. mujtabai, Telotylenchus historicus and T. aerolatus. The species, Clavilenchus tumidus,

Ditylenchus microdens and Tylenchorhynchus goffarti are new records for India. A detailed study on the intraspecific variations of Tylenchorhynchus mashhoodi has been done and T. dactylurus, T. digitatus, T. crassicaudatus, T. elegans and T. zeae have been synonymized with it. Psilenchus hilarus has been considered a synonym of P. neoformis. The nematodes of the family Hoplolaimidae belong to 10 known species, of which Helicotylenchus egyptiensis and H. pseudorobustus are recorded for the first time from India. The families Neotylenchidae, Hemicycliophoridae and Aphelenchidae are each represented by single species, namely Dorsella indica, Hemicycliophora eugeniae and Aphelenchus avenae respectively.

The Order Dorylaimida is represented by 15 families. Under the family Dorylaimidae a new genus Willinema has been proposed and the following 6 new species are described: Willinema indicum, Pungentus angulatus, Discolaimium mazhari, D. upum, D. mukhtarpuriensis and D. longicaudatum. Two new combination, Thornenema mauritianum and Willinema parvum are proposed. Thornenema baldum and T. mauritianum have been redescribed in details; Thornenema paradoxum is regarded a synonym of T. baldum, and Thornenema viriosum, T. filiforme, T. delhiensis, T. africanum and Chrysonema mauritiana are synonyms of T. mauritianum. Males of Thornenema baldum have been reported for the first time in the genus. Five new species, Aporcelaimellus heynsi, A. indicus, A. hemicaudatus, A. raisi and Sectonema procta have been described under the family Aporcelaimidae. Family Longidoridae includes 7 known

species of which Longidorus sylphus and L. laevicapitatus are new records for India. Under the family Leptonchidae, Morasia dimorphicauda n. gen., n. sp. and the new combination Morasia rhabdotus have been proposed to accommodate those species of Dorylaimoides which possess dissimilar tails in the sexes. The family also includes the following 4 new species: Leptonchus capitatus, Dorylaimoides constrictus, D. grandis and D. arcuicaudatus. The males of Dorylaimoides arcuatus and D. parateres have been recorded for the first time for these species. The family Belonenchidae is represented by Basirotyleptus basiri. Blondira paraclava which belongs to the family Belondiridae has been re-validated. The family Oxydiridae includes some discussion on Oxydirus magnus and O. gigas. Oxydirus oxycephalus and O. magnus have been recorded for the first time from India. The family Dorylaimellidae is represented by 2 new and 8 known species. Dorylaimellus jacobi and D. deviatus are new species, while D. projectus is a new record for India. The descriptions of Dorylaimellus discocephalus, D. indicus, D. longicaudatus and D. parvus have been amplified. Dorylaimellus pruni has been synonymized with D. indicus. The family Trichodoridae is represented by Trichodorus mirzai. Under the family Alaimidae, a new species Amphidelus novus is described and A. dudichi is recorded for the first time from India. The family Bathyodontidae is represented by Oionchus obtusus.

The quantitative and qualitative studies revealed that the species of the genera Tylenchorhynchus, Hoplolaimus,

Helicotylenchus, Tylenchus, Ditylenchus, Pratylenchus and Aphelenchus are widely distributed. The genera Eudorylaimus, Mesodorylaimus, Labronema, Thornenema, Discolaimium and Dorylaimellus are also of common occurance.

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